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USSR REPORT

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CONTENTS

OCEANOGRAPHY

PHYSICS OF ATMOSPHERE

OCEANOGRAPHY

'AKADEMIK VERNADSKIY' PREPARING FOR NEXT PACIFIC VOYAGE

Kiev PRAVDA UKRAINY in Russian 1 Jul 81 p 4

[Article by V. Petrenko: "Course to the Tropics"]

[Text] The "Akademik Vernadskiy," a scientific research ship of the Ukrainian Academy of Sciences, under the command of Captain A. Ye. Stepanov, is completing preparations for departure on its 24th voyage, which will last almost five months. The expedition is headed by Candidate of Physical and Mathematical Sciences R. Kh. Grek, a laboratory head at the Marine Hydrophysical Institute of the Ukrainian Academy of Sciences.

Seychelles Islands, Madagascar, New Hebrides, Tonga, Fiji, Western Samoa. Who in their school geography lessons was not enthralled by these names, creating visions of romantic winds, of distant voyages, of the bright exotic tropics!

These and other points are plotted on a map which was shown me at the Presidium of the Ukrainian Academy of Sciences by the Scientific Secretary of the Section on Marine Expeditionary Work, Candidate of Technical Sciences N. G. Mikhaylov. The red line representing the expedition's track ran from Sevastopol' through the Black Sea, Sea of Marmora, Aegean Sea, Mediterranean Sea, Suez Canal and the Red Sea into the Indian and Pacific Oceans.

"In comparison with most preceding voyages," says Nikolay Grigor'yevich, "in the present program, in addition to a complex of hydrophysical investigations, an appreciable place will be occupied by the work of professional biologists. In the tropical and subtropical regions there are more than 200,000 species of higher plants, including 40,000-45,000 which are endemic (that is, those which grow only in a definite place and are not encountered elsewhere).

The first stop is planned for the port of Candia on the Greek island of Crete. In the Indian Ocean plans call for a call at the port of Victoria on Mahe Island and a landing on Praslin Island (Republic of the Seychelles Islands), and then calls at Port Louis (Mauritius) and at Tamatave on Madagascar.

1

Bending around Australia and New Zealand, the red line of the expedition's track leads to the islands of Oceania. In the Pacific Ocean landings are planned on Tongatapu Island in the Tonga Archipelago, Upolu (Western Samoa), Viti Levu (Fiji), Efate (New Hebrides) and possibly with calls at Port Moresby and Lae (Papua-New Guinea). The program for the final stage of the investigations provides for calls at Singapore, the Indian port of Madras and at Colombo (Sri Lanka).

"The expedition," continues N. G. Mikhaylov, "includes scientists from the Botany Institute imeni N. G. Kholodnyy and the Central Republican Botanical Garden of the Ukrainian Academy of Sciences, as well as bontanists from institutes of the USSR Academy of Sciences and the republic academies of sciences of the Armenian, Georgian, Lithuanian, Moldavian and Estonian SSRs.

"The program for the voyage," said Corresponding Member Academy of Sciences Ukrainian SSR Yu. R. Shelyag-Sosonko, deputy head of the expedition, on the eve of the departure from Kiev for Sevastopol', "provides for floristic, geobotanical, botanical-geographic and marine preservation studies, as well as adding of new materials to our herbariums and the collections of tropical and subtropical plants in museums and botanical gardens. The scientific program for the 24th voyage of the "Akademik Vernadskiy" also includes hydrological, hydrochemical, hydrooptical and hydroacoustic investigations.

"One of the principal tasks, the implementation of work within the framework of the climatic program, is the study of how the ocean exerts an influence on physical processes in the atmosphere and on weather in different regions of our planet," says the director of the Marine Hydrophysical Institute Ukrainian Academy of Sciences Academician B. A. Nelepo. "In these fundamental and applied hydrophysical investigations, carried out jointly with colleagues from the institutes of the USSR Academy of Sciences, use will be made of both a variety of on-board and over-the-side instruments on the 'Vernadskiy,' but also 'upper-level' instruments, on-board scientific instrumentation of the artificial earth satellites 'Cosmos-1151' and the 'Intercosmos-21.' In addition, a study will be made of the variability of equatorial currents during the period of the southwesterly monsoons. Joint investigations have also been carried out with an expedition of the 'Azcherryb' Combine in the Indian Ocean."

5303
CSO: 1865/207

2

SOVIET UNDERWATER ROBOT EXHIBITED IN MONTREAL

Moscow MOSKOVSKAYA PRAVDA in Russian 4 Jul 81 p 3

[Unsigned article]

[Text] An unusual exhibit, a development of the Moscow Higher Technical School
imeni N. E. Bauman, has been delivered to Montreal for exhibition at the USSR
exhibit "Man and His World."

It has been designated the TEKSPA, an abbreviation of the first letters of its
technical designation: telecontrolled experimental wheeled self-propelled under-
water vehicle (teleupravlyayemyy eksperimental'nyy kolesnyy samokhodnyy podvodnyy
apparat). However, such a rather detailed interpretation of the name of the robot
only excites our interest and by no means satisfies curiosity. For this reason we
will tell about the vehicle in greater detail.

The TEKSPA outwardly resembles a crab. In front there are two large bulging eyes,
above them a steel claw, and two boxes in which are placed the control systems,
still further accentuating the similarity to this crustacean. Four wheels enable
the robot to move along the sea floor in any direction. If it suddenly meets with
a small obstacle it can be easily overcome: the wheels are raised, increasing the
space between the bottom of the vehicle and the sea floor.

But here it is necessary to take a sample of the bottom or a sample of sea floor
fauna. The claw enters into operation. By precise movements it takes an object
and puts it in a basket. The manipulator operates very freely, can be turned to the
right and left, be raised and lowered, be made longer or shorter. If an instrument
is attached to the end of the claw its functions will become still broader.

The underwater robot performs 32 commands. And it is controlled from the shore. A
command point is set up there: a television screen, control lever and such instru-
ments as a banking indicator and a course indicator. There are two persons at the
control panel: commander and navigator. One gives signals and the other lays the
course. The commands are transmitted by cable. Within the robot hull there are
television cameras, three powerful searchlights, different measuring instruments and
an engine.

3

The TEKSPA sent to Montreal is not the first underwater vehicle developed and constructed in the student design bureau of the Moscow Higher Technical School. There an entire "Akvamarin" [Aquamarine] program is being carried out. It provides for the creation of a series of remote-controlled vehicles for investigating the seas and oceans. Some robots have already been used in practical work on the sea floor.

In the future the system for control of underwater robots is visualized by its creators as follows. Elastic cuffs with miniature sensors on the inner side are attached to the operator's arm. They register the biopotential of the muscles and transmit pulses to the vehicle. In short, in the future the robot will become a sort of extension of man.

5303
CSO: 1865/208

NEW UNDERWATER ROBOT

Moscow VECHERNYAYA MOSKVA in Russian 7 Aug 81 p 3

[Article by V. Nyrko: "Underwater Robot"]

[Text] The "Skat-geo" underwater robot has been developed in conformity to the specifications of the Central Scientific Research Institute of Geodesy, Aerial Mapping and Cartography. As is fitting for an inhabitant of the sea, it is quite similar to a fantastic fish. In size it is close to that of a good-sized shark, a little less than three meters. Two paired containers are covered with a streamlined Dural shell. Lowered from a ship and supplied with a programmed mission, the robot can operate independently under water for six hours. Five electric motors ensure maneuverability and a good speed.

Being oriented on specially placed buoys, the robot is capable of operating in a radius of two or three kilometers. The depth of its submergence is up to 300 m. In order to avoid obstacles the "Skat-geo" sends out ultrasonic signals, which upon being reflected are returned to it. As a result, the robot itself bypasses these obstacles.

The "Skat-geo" is outfitted with different types of depth meters, cameras, television "eyes" with a videomagnetic recorder and other instrumentation necessary for carrying out its investigations.

Once during the tests a storm developed at sea. The specialists became worried, but the "Skat-geo" did not roll over; it surfaced and was found due to a flashing signal mounted on its hull.

The robot discussed here can be employed in investigations of the bottom topography and bottom materials and in a search for minerals, underwater vegetation and animal life. The "Skat-geo" is even capable of detecting objects concealed beneath a silt layer.

UPCOMING OCEANOGRAPHIC EXPEDITIONS

Moscow VODNYY TRANSPORT in Russian 16 Jul 81 p 4

/Interview with A. Monin, director of USSR Academy of Sciences Institute of Oceanology; name of interviewer, time and place of interview, and article title not provided/

/Excerpt/ /Question/ Which new discovery in oceanology arouses the greatest interest? What can one say about the latest achievements of Soviet oceanologists?

/Answer/ The discovery of so-called synoptic eddies was the most significant. They arise suddenly and travel along the ocean's surface in different directions for hundreds of kilometers. The eddies, like cyclones and anticyclones in the atmosphere, affect the weather in the ocean.

/Question/ The USSR Academy of Sciences has a large research fleet. Underwater apparatuses aid oceanologists in the study of the ocean's bottom. What kind of future is in store for them?

/Answer/ In the upcoming months we expect to receive the new ship "Vityaz'" from Poland. It will replace the famous "Vityaz'" which sailed for 30 years.

/Question/ To which regions of the world's oceans does the institute intend to direct its expeditions this year?

/Answer/ The very largest will be the expedition "Vostok-81" in the northern section of the Pacific Ocean. During the summer the "Dmitriy Mendeleyev" from Vladivostok and the "Akademik Kurchatov" from Kaliningrad will sail on a multimonth cruise. This will be a hydrophysical expedition which will continue the study of synoptic variability of currents and temperature. For the first time, the new ships "Akademik Mstislav Keldysh" and "Vityaz'" will conduct investigations in the Barents Sea.

CSO: 1865/231-P

6

HYDROPHYSICAL INSTRUMENTATION AND COMPUTER COMPLEX

[Paper by Ye.G. Nechesin, A.V. Nikitin, A.N. Paramonov, Ye.I. Timofeyev and Yu.I. Shapovalov]

[Text] The experimental study of the ocean at the present time is characterized by a systems approach: topical goal oriented expeditions of scientific research vessels are organized, comprehensive studies of physical processes and phenomena on various scales are carried out and their interaction and development is being studied. When performing a controlled experiment in the ocean, the information should be processed and the results analyzed directly during the observation process in real time.

Such studies cannot be carried out without automating the experiment, primarily using computer equipment. For this purpose, automated information systems are being created on scientific research vessels, where these systems have a hierarchical multiply connected structure [1]. Instrumentation computer complexes are being developed as one of the components of this structure, which not only perform the conversion and visualization of the quantities being measured, but also provide for automation of the collection and primary processing of the measurement data, its storage for the creation of a data bank as well as the output of the results on a display. The most effective approach to design such complexes around specialized mini and microcomputers.

An instrumentation computer complex to study small scale oceanic turbulence under local hydrological conditions has been designed and developed at the Maritime Hydrophysical Institute of the Ukrainian SSR Academy of Sciences. The following are determined as the informational characteristics of small scale turbulence: estimates of the spectral power density of the pulsations in the longitudinal component of the current velocity at fixed wave numbers and the parameters of a mathematical model of the one-dimensional spatial spectrum of the turbulence. The temperature, salinity, sea water density and the vertical density gradient, which govern local hydrological conditions, are measured synchronously with the determination of the spectral characteristics. Moreover, the immersion depth of the instrument and the average velocity of the incident flow are measured.

The progressive concept of buswise organization and modularity of the functional assemblies has been taken as the basis for the design of the instrumentation computer complex; this concept provides for the capability of adding-on and optimizing at each stage of development. A block diagram of the complex is shown in Figure 1, and it incorporates the following components:

--Two sets of specific electrical conductivity meters, sea water temperature and hydrostatic pressure meters: the IPP1 and IPP2 of the "Istok-5" type [2];

--An electromagnetic type meter for the pulsations in the longitudinal component of the current velocity: EMKA [3] and a set of analog bandpass filters-resonators for a spectrum analyzer;

--A hydrodynamic type meter for the average incidence flow velocity: the ISP;

--An operator's console of the complex for specifying the initial conditions, selecting the operational program for the complex and status display for the hardware;

--A subscriber address decoder;

--A priority and code generation unit for nonprogrammable instructions;

--A specialized digital computer: the SVM;

--A miniature printer with a controller;

--A tape puncher with a controller;

--Analog recorders;

--The communications trunk.

The complex consists of the submersible and on-board equipment sets, which are connected by a cable. The maximum cable length is governed by the maximum submersion depth of the instrument and amounts to 500 meters. All of the meters are incorporated in the submersible unit.

In structural design terms, it is made in the form of a steel frame, on which the hydrological parameter meters are mounted at the one meter level relative to the vertical, while the meters for the pulsations in the flow velocity and the average velocity of the incident flow are positioned between them. The equipment is oriented relative to the flow by means of two tail stabilizers.

Each hydrological parameter meter performs the measurement, conversion to digital form and transmission of the four values of the specific electrical conductivity, sea water temperature, hydrostatic pressure and the regulated control voltage during one measurement cycle, which is equal to 0.25 or 1 sec. The conversion to digital form is accomplished by means of high speed 14-bit converters. Two check bits are generated in the monitor unit. The data is transmitted via a
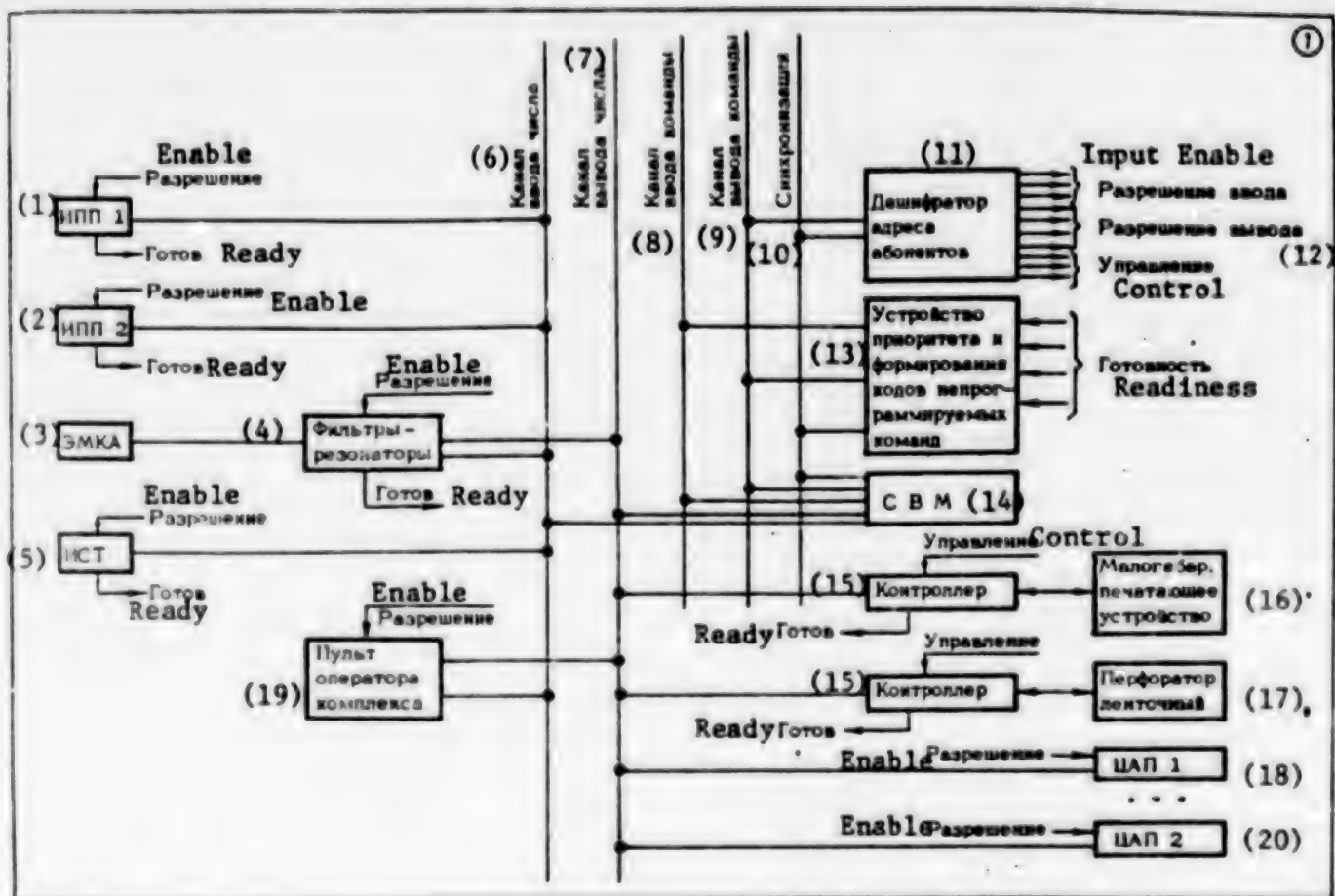
Figure 1. Structure of the hydrophysical instrumentation computer complex.

Key: 1. IPP1 [set 1 of meters for the specific electrical conductivity, sea water temperature and hydrostatic pressure];
2. IPP2 [meter set 2];
3. EMKA [electromagnetic type meter for the pulstations in the longitudinal component of the current velocity];
4. Resonator-filters;
5. IST [hydrodynamic type average incident flow velocity meter];
6. Number input channel;
7. Number output channel;
8. Instruction input channel;
9. Instruction output channel;
10. Synchronization;
11. Subscriber address decoder;
12. Output enable;
13. Priority and nonprogrammable instruction code generation unit;

[Key to Figure 1, continued]:

    14. SVM [specialized digital computer];
    15. Controller;
    16. Miniature printer;
    17. Tape perforator;
    18. Digital/analog converter 1;
    19. Operator's console for the complex;
    20. Digital-analog converter 2.

communications cable to the on-board unit in a series code. The maximum data input rate from each hydrological parameter meters amounts to 256 bit/sec.

The spectral analysis of the signal from the meter for the pulsations in the longitudinal component of the current velocity is accomplished in analog form by means of parallel filtering using bandpass filter-resonators [4]. The transition is made from the timewise characteristics to the spatial ones while taking into account the "frozone turbulence" hypothesis. The constancy of the wave numbers at which the spectral components of the current velocity pulsations are determined is achieved by automatically tuning the resonant frequencies of the bandpass filters in accordance with the measurement data on the average velocity of the incident flow. The signals from the outputs of the filters are converted to digital form by means of ten-place analog to digital converters. A check bit (modulo 2 addition) is generated in the monitor unit. Depending on the operational mode of the complex, the 11-digit codes are fed from the output of each filter to the trunk at a frequency of 512 or 2,048 Hz. Nine-bit information codes (eight information bits and one check bit) are fed from the meter for the average flow velocity at a frequency of one Hz.

Each meter has an interface output, which converts the format of the meter data to the standard format of the complex and organizes the reception of the exchange enable signal and the generation of the exchange readiness signal. A 24-bit supplemental modified code with two check bits, with which the specialized digital computer operates, has been adopted in the trunk as the standard format.

The specialized digital computer interface was taken as the basis in the construction of the specialized instrumentation interface. The interface trunk consists of 128 buses, grouped according to functional operations into four channels, and eight synchronization and control buses. The designation and composition of the channels are as follows:

--The numerical data output channel, incorporating 24 output buses of a parallel 24 or 12 bit code, two check bit buses and four operations buses (two for a programmable and two for a nonprogrammable output);

--An instruction data output channel, including 16 permanent storage address code output buses, 16 main memory address code output buses and 7 operation code output buses;

10

—A numerical data input channel, including 24 input buses for a 24 or a 12-bit code, two check bit buses, two operations buses (for a programmable and nonprogrammable input) as well as one bus for the SBOY VVODA [DUMP INPUT] signal;

—An instruction data input channel, incorporating 24 parallel code input buses for nonprogrammable instructions, two check bit buses, one operation bus for a nonprogrammable instruction, two buses for reciept signals for the reception of the nonprogrammable instruction codes and one bus for signals on the dumping of a nonprogrammable instruction.

Moreover, the exchange is synchronized via six buses and signals concerning the proper operation or failure of the digital computer are fed out via two separate buses. The interface trunk allows for a maximum exchange rate of 150,000 26-bit words per second.

The fastest method of data exchange between the peripherals the main memory by means of direct access channels has been realized in the complex.

Because of the presence of an instruction output channel, a definite magnetic core storage location is signed to each subscriber in the organization of the data exchange in the complex, i.e., a magnetic core storage location address defines a subscriber address. All of the subscribers tied into the interface trunk are broken down into two groups:

—Subscribers ready for exchange at any point in time. These include the registers of the complex operator's console and the digital-analog converters of the analog recorders;

—Subscribers with a short data storage time, the exchange with which is realized to the extent that they are ready. These include the hydrological meters, the meters for the pulsations in the current velocities and the average flow velocity as well as the digital recorder.

Exchange is carried out with the first group of subscribers at the initiative of the specialized digital computer in accordance with programs by means of input-output instruction at specified points in time in the measurement cycle, which are determined by the dispatcher program. With the arrival of an input-output instruction, the specialized digital computer writes its address portion into the subscriber address decoder via the instruction output channel. The selected subscriber is prepared for the exchange by the gating signal from the output of the INPUT-OUTPUT ENABLE decoder. The data is transmitted between the subscriber and the core storage location, the address of which is likewise specified by the address portion of the instruction, via the input-output channels for the numerical data over one operational cycle of the specialized digital computer.

Data exchange is set up asynchronously with the second group of subscribers using readiness signals by means of a nonprogrammable interrupt and stop instruction.

11

A meter which is ready to feed out data generates the GOTOVNOST' [READINESS] signal, which is picked up by the priority and nonprogrammable instruction codes generating unit. When authorization is present from the priority unit, the address portion, the input operation code and the NK nonprogrammable instruction sign are generated, which are fed out into the instruction input channel. The address portion of the instruction is picked up by the subscriber address decoder.

The RAZRESHENIYE VVODA [INPUT ENABLE] signal which is generated is fed to the meter which is ready for exchange and switches its output to the numerical data input channel buses. In accordance with NK indicator, the specialized digital computer ceases the execution of the current program and carries out the nonprogrammable input instruction which has arrived via the instruction input channel. The numerical input data from the meter is written into the magnetic core storage location via the numerical data input channel, where the address of this location is indicated in the code of the nonprogrammable instruction. The execution of the indicated instruction does not change the current data in the specialized digital computer registers, and for this reason, such a query is serviced in any operational cycle of the computer. The main program is stopped following the execution of the machine cycle, during which the stoppage query has arrived. The access time for the execution of nonprogrammable input instructions does not exceed 8.5 microseconds.

A combined method is used for exchange with the digital recorders by means of programmable and nonprogrammable instructions. The data is fed out to the digital recorders at the initiative of the specialized digital computer, to the extent that a data file is ready, by means of module for the organization of the operation of the dispatcher program output units. The periodicity for the actuation of these programs is specified from the complex operator's console and is monitored by means of indicators by the dispatcher program. In this case, the specialized digital computer exchanges the addresses of subscriber with the decoder via the instruction output channel by means of the output instruction code, the address portion of which is decoded as a controlling signal to turn on the recorder. Following the run-up of the recorder motor, the READY signal is fed out, which arrives at the priority and nonprogrammable instruction code generation unit.

Taking the priority of the recorder into account with respect to other subscribers, the nonprogrammable instruction code is generated in the unit for the unconditional transfer of control, which is fed via the instruction input channel to the specialized digital computer. In this case, the current program is interrupted and the specialized digital computer switches over to the execution of the program for exchange with the recorder. The maximum access time for the execution of a nonprogrammable interrupt instruction does not exceed 93 microseconds.

The requisite memory storage of the contents of the specialized digital computer registers and their restoration when returning to the main program are realized by the interrupting program.

The quantity of data needed to record one line of symbols is fed out in accordance with the exchange program. The codes from the locations of the magnetic core storage are rewritten via the numerical output channel into the recorder buffer using the same algorithm as for the first group of subscribers.

With this, the process of servicing the incoming query is completed, and the specialized digital computer switches over to operation in accordance with the main program. Subsequently, all of the functions for the output of a numerical data line are taken over by the recorder controller. Subsequent accesses to the exchange program are made asynchronously following the recording of a symbol line in accordance with the readiness signal from the unit and taking the priority into account. Thus, the maximum independence is achieved between the computing process and the data output process.

Having completed the output of an entire data file, the dispatcher program, in accordance with the indicator for the end of the output data, turns the recorder off through the address decoder.

The software system which has been developed also has a modular structure. The software of the complex includes the operating system, the routines for calculating the spectral characteristics and hydrological parameters, diagnostic test routines for checking the operability of the special digital computer and the input-output channels, a functional monitoring program, programs for data output to analog and digital recorders as well as subroutines for calculating standard functions. The programming software structure of the complex is shown in Figure 2.

The operating system is intended for the execution of the common algorithm for the automated functioning of the complex and is oriented towards real time data processing. The basis for the operating system is the dispatcher program, which is located in the permanent storage of the specialized digital computer and occupies 1,152 memory locations. A specific feature of the computer which is used in the complex is the fact that all of the program modules occupy fixed portions of the permanent storage. The programs for processing and data output to the recorders are accessed in accordance with program indicators, and in accordance with external interrupt from the timer and from the digital recorders.

The basic timing unit is the time for one measurement cycle of the hydrological parameters, which, depending on the operational mode, is either 0.25 or 1.0 sec. Upon completing a measurement cycle, the timer, which is included in the complement of the unit for generating the nonprogrammable instruction codes, generates a non-programmable unconditional control transfer instruction. The current program is interrupted and a batch of processing routines is started. They are executed sequentially one after the other. During the time for running the date rewrite program, the dispatcher blocks the generation of a nonprogrammable instruction. Thereafter, the block is removed, data input from the meters is enabled as well as the output of the results to the digital recorders.

The dispatcher programs synchronizes the operation of the units of the complex in the data averaging and accumulation cycle. To account for the nonsteady-state nature of oceanic turbulence, a provision is made for averaging over several time intervals with durations of 10, 20, 40 and 80 seconds or over spatial intervals with lengths of 20, 40, 80 and 160 meters. The conditions of the averaging are specified by the operator. The operator is coupled to the specialized digital computer by means of multiposition and toggle switches on the control console of the complex.

13

Th: :perability of the comple:: is monitored prior to starting and upon completing an e >periment using the functional monitoring prog.am. In this case, all of the hardware and channels of the complex are encompassed by the monitoring, with the exception of the sensors. The results are printed out on a digital printer. The operational monitoring of the instrumentation channel, the numerical data input-output channels and the magnetic core storage channel is accomplished continuous.y during each measurement cycle using check codes fed in from the hydrological parameter meters. When the incoming codes match constants which were determined when calibrating the meters, normal operation signals for the hydrological para-meter meters are generated with the participation of the dispatcher program. The passage of these signals is indicated on the operator's console. The monitoring of all of the data incoming to the specialized digital computer via the instruction and numerical input channels is accomplished using check bits.
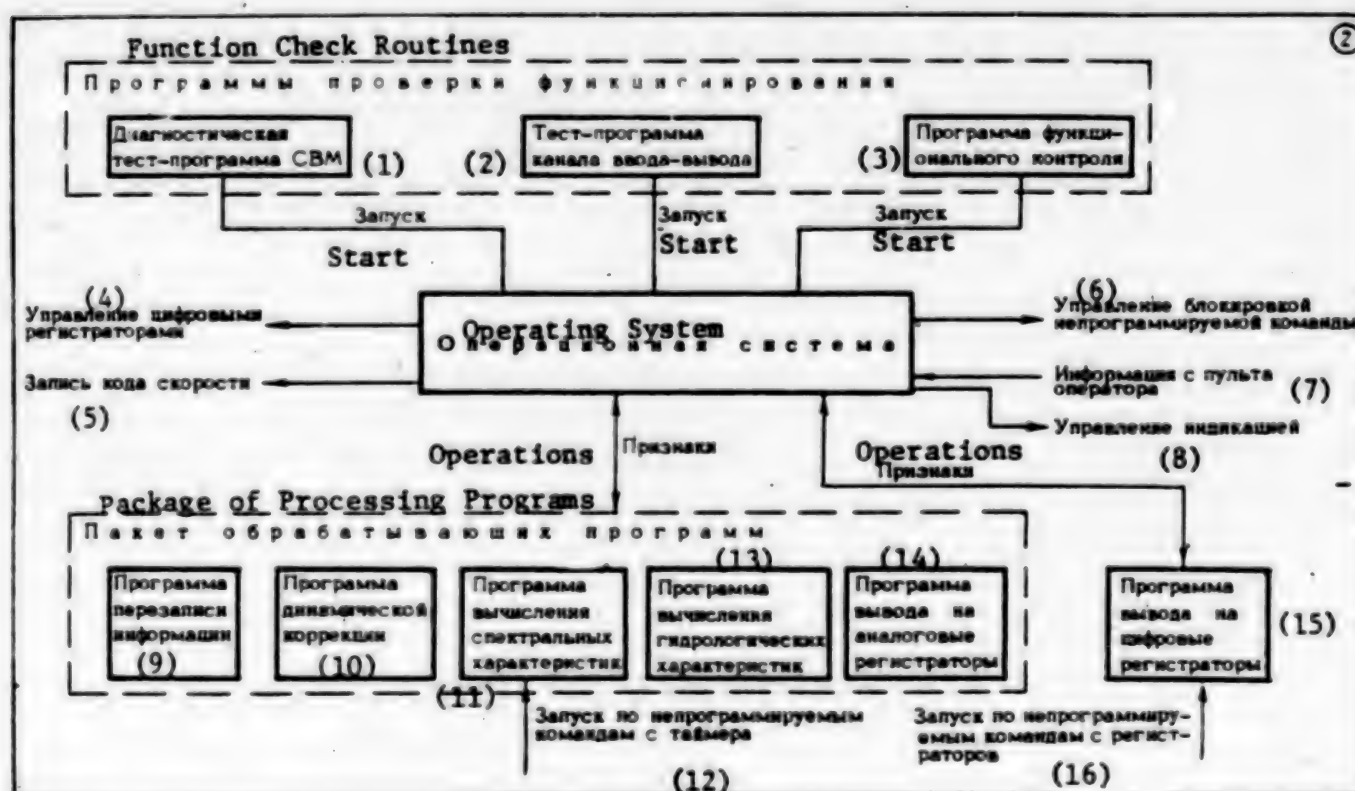
Figure 2. The software structure.

Key: 1. Specialized digital computer diagnostic test routine;
2. Input-output channel test routine;
3. Functional monitoring routine;
4. Control of the digital recorders;
5. Rate code write;
6. Control of the blocking of a nonprogrammable instruction;
7. Information from the operator's console;
8. Readout control;
9. Data rewrite program;
10. Dynamic correction program;
11. Program for computing the spectral characteristics;

[Key to Figure 2, continued]:

12. Starting using nonprogrammable instructions from the timer;
13. The program for calculating hydrological characteristics;
14. Program for the output to the analog recorders;
15. Program for output to the digital recorders;
16. Starting using nonprogrammable instructions from the recorders.

The date from the meters is processed in real time. A polynomial approximation of the graduated characteristics of the meters is used to calculate the physical values of the hydrological parameters being measured as well as the average incident flow velocity.

The dynamic characteristics of the measurement channel are corrected by means of digital second order recursive filters. The difference equations, which describe the operation of the filters, have the following form when written in canonical form:

$$y(nT_s) = 4b_0 x(nT_s) + 4y_1(nT_s - T_s),$$
$$y_1(nT_s) = b_1 x(nT_s) + 0.5a_1 y(nT_s) + y_2(nT_s - T_s),$$
$$y_2(nT_s) = b_2 x(nT_s) + 0.5a_2 y(nT_s),$$

where $x(nT_s)$ is the discrete representation of the signal at the filter input; $Y(nT_s)$ is the discrete representation of the signal at the filter output; a_i and b_i are the values of the coefficients which are chosen as a function of the dynamic characteristics of the measurement channels.

The indirectly measured parameters are calculated from the results of direct measurements of the temperature, specific electrical conductivity of the sea water and the hydrostatic pressure: the immersion depth of the instrument, salinity, the conditional sea water density and the vertical density gradient.

The polynomials derived in [5, 6] were used to calculate the salinity S and the conditional sea water density at atmospheric pressure σ_t. These polynomials have the form:

$$y = \sum_{i=0}^{4} a_i \cdot t^i + x_{St0} \sum_{j=0}^{3} b_j \cdot t^j + x_{St0}^2 \sum_{k=0}^{1} c_k \cdot t^k \tag{1}$$

and depending on the values of the coefficients a_i, b_j and c_k also make it possible to calculate the salinity and the conditional density. In expression (1), x_{St0} is the value of the specific electrical conductivity at atmospheric pressure, which is determined from direct measurements of x_{StP} using the formula given in [5].

The conditional sea water density at a definite depth σ_{StP} is computed from the formula [7]:

15

$$a_{SIP} = \sigma_t \sum_{i=0}^{2} a_i \cdot P^i + P \sum_{j=0}^{2} b_j t^j + \sigma_t \cdot P \cdot t \sum_{k=0}^{1} c_k \cdot t^k.$$

Интервал ос-реднения, м (1)	Относительная среднеквадратическая погрешность ε (в %) при различных значениях волновых чисел k (в м⁻¹) (2)			
	1.5	3	15	30
10	35.9	25.9	13.2	10.5
20	25.9	19.0	10.5	8.9
40	19.0	14.3	8.9	7.9
80	14.3	11.4	7.9	7.4
100	11.4	9.5	7.4	7.1

Key: 1. Averaging interval, meters;
2. Relative mean square error
ε (in percent) for various
wave number values k (in m⁻¹).

The algorithms used for calculating the hydrological parameters were specially developed taking into account the application of micro and minicomputers. Their realization requires minimal machine time expenditures and minimal memory loading. At the same time, they provide for the requisite computational precision.

Estimates of the spectral power density of the pulsations in the longitudinal current velocity component are determined using the algorithm given in [4]:

$$E(k_i) = \frac{1}{K_{ob}^2 \, \alpha_{\nu\phi} \, k_i N_0} \cdot \sum_{n=0}^{N_s-1} Y_i^2(nT_k).$$

where $Y_i(nT_k)$ is the discrete representation of the signal at the output of the i-th filter; T_k is the digitization period of the signals from the filter outputs; K_{ob} is the general transmission gain of the measurement channel for the current velocity pulsations; N_0 is the number of summings over the averaging time ($T_0 = 10, 20, 40$ and 80 sec) or in the case of averaging on spatial scales ($L_0 = 20, 40, 80$ and 160 m); k_i is the wave number for which the estimate is determined.

The spectral parameters are calculated assuming a very simple one-dimensional model for the spatial energy spectrum of the turbulence $E(k) = C \cdot k^{-\alpha}$. In the case of a piecewise-linear approximation of this function, the parameter α_i is determined from values of the logarithms of the estimates for two adjacent wave numbers k_i and k_{i+1}:

$$\alpha_i = \frac{\lg E(k_i) - \lg E(k_{i+1})}{\lg k_{i+1} - \lg k_i}.$$

The relative mean square error in the determination of the estimates of the spectral power density of the pulsations in the longitudinal component of the current velocity for wave numbers k in the case of various spatial averaging intervals is given in the table.

16

The existing prototype of the complex has undergone universal laboratory and sea trials, which have confirmed the stability of the metrological characteristics and the operational reliability. Studies of turbulence characteristics under local hydrological conditions in the tropical Atlantic and in a test area in the Black Sea were carried out using the complex.

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APPARATUS FOR IMPLEMENTING OCEANOGRAPHIC WORK ON ICEBREAKER 'OTTO SHMIDT'

STARSHINOV, V. A. and KUPERMAN, A. M.

[Abstract] The scientific research icebreaker "Otto Shmidt' is outfitted with a wide range of special apparatus for implementation of oceanographic work over the side while navigating in the ice. This equipment is for solving problems in the fields of oceanology, hydrology, hydrochemistry, and also in carrying out ice research work. (The icebreaker itself was described in SUDOSTROYENIYE, No 9, 1980) The vessel has seven electric winches for lowering and raising instruments on a cable; the technical specifications of these winches are summarized in Table 1. There are eight maneuverable booms for supporting the cable and extending the instruments beyond the ship's side; the technical specifications of these booms are summarized in Table 2. Figure 1 is a diagram showing placement of different types of apparatus, instrumentation and laboratories aboard the ship; Fig. 2 is a diagram of the guide pulleys used on these booms and the newly devised device for cleaning ice-covered cables raised from the sea; Fig 3 illustrates the apparatus and instrumentation employed in actinometric investigations; Fig. 4 is a diagram of the maneuverable boom employed with the actinometric apparatus; Fig. 5 gives the design of a special bottom cover for the vessel's hydrological shaft. There is an extensible telescopic apparatus for actinometric research which makes it possible to extend the instrumentation 8-10 m beyond the ship's stem. This telescopic apparatus consists of a platform which moves along roller bearings and in guides attached to the deck. The boom, along which the instruments are placed, can be rotated up to 180° in the vertical plane. (Details are given concerning design and functioning of the actinometric outfit.) A special innovation aboard the "Otto Shmidt" is the covering at the bottom of the hydrological shaft, which is used under ice conditions when the lowering of instruments over the side is impossible. This shaft, 800 mm in diameter, extends from the bottom of the ship to its upper deck. The shaft contains a LOKS1 cable winch, manual winches, supports and other apparatus. Under ordinary conditions oceanographic ships have a shaft which need not have a closure at the bottom, but when operating in the ice the entire shaft would be quickly jammed with ice. The special bottom covering introduced on the "Otto Shmidt" precludes this, at the same time ensuring centering of the cable with the instrumentation relative to the shaft walls. Figures 5, tables 2.
[219-5303]

EXPEDITIONARY INVESTIGATIONS IN NORTHWESTERN INDIAN OCEAN ON 22d VOYAGE OF
SCIENTIFIC RESEARCH VESSEL 'AKADEMIK VERNADSKIY'

AGAFONOV, Ye. A., KOSNYREV, V. K., URDENKO, V. A. and SHCHETININ, Yu. T.

[Abstract] Expeditionary work in the northwestern part of the Indian Ocean was
carried out during the period March-July 1980 by the Marine Hydrophysical Institute,
Ukrainian Academy of Sciences, in collaboration with the Institute of Biology of the
Southern Seas and the Sea of Azov-Black Sea Scientific Research Institute of
Fishing and Oceanography, under the interdepartmental program "Multisided Investi-
gations of the Fishing Resources of the Indian Ocean." The expedition carried out
a broad program of physical, chemical and biological investigations. The work was
done in two large and two small polygons which covered virtually the entire open
part of the Arabian Sea. A total of 302 stations were occupied with a distance
between them of 60 miles along the meridian and 40 miles along the parallel in the
first major survey and 40 and 30 miles respectively in the second. At these
stations soundings were made to a depth of 1,500 m with the ISTOK apparatus and
standard bathometric observations were made to a depth of 500 m. Other measure-
ments were made at the horizons 25, 50, 100, 200, 400, 900 and 1,500 m. In June
1980 work was done in the Red Sea, along whose axis eight hydrological stations were
occupied. Daylong stations were occupied in the Mediterranean and Black Seas for
nuclear hydrophysics studies. The work began at the ending of the winter monsoon,
most of the work was done in the transitional period during calm weather, and the
final phase coincided with the onset of the summer monsoon. The synoptic variabil-
ity of water dynamics in the investigated region was characterized by the presence
of eddy formations with a characteristic scale 60-200 miles. Seven cyclonic and
five anticyclonic eddies were found. Their intensity was relatively small: the
maximum rising of the 16° isotherm, selected for mapping the eddy field, did not
exceed 60 m. A distinguishing characteristic of all these eddies was their close
correlation with water stratification. Virtually no eddy formation was manifested
at the ocean surface in the form of a temperature anomaly. The eddies were most
clearly expressed in the layer 100-400 m. Sometimes the eddy formations could be
traced readily on the basis of salinity anomalies at the ocean surface. The
synoptic variability of the ocean in this region was also characterized by the
presence of a hydrological front intersecting the polygon from southwest to north-
east. Meandering at the front may be one of the reasons for eddy formation. Eddy
formations were also generated by changes in the wind and the dynamics of waters in
the coastal regions of the Arabian Peninsula and the Malabar Coast of Hindustan.
An exceedingly rapid variability in the configuration of the eddy formations was
observed. The investigated area was characterized by a three-layer structure of
the distribution of chemical characteristics. During the summer monsoon there was

an insignificant decrease in the level of primary production of organic matter. During both the winter and summer monsoons there was a considerable spottiness in the distribution of productive zones. There was no significant difference in the sound-scattering layers in different seasons. The observations of eddy formations provided much material for determining the qualitative relationships between the dynamic characteristics of eddies, transport of suspended and dissolved matter and structure of biological communities. Figures 1.
[243-5303]

DISTORTIONS OF CONTINUOUS SEISMIC PROFILING RECORDS WITH ACOUSTIC NONUNIFORMITIES OF SEDIMENTARY LAYERS

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[Abstract]   In work by the continuous seismic profiling method in the Baltic Sea the seismic record revealed a large number of deformations of reflecting boundaries in the upper parts of the lithological section: breaks with a vertical displacement of layers, folded zones, anticlines, synclines, flexures and zones of scattering of seismic waves. The nature of such deformations has remained debatable, warranting this investigation of the problem. An analysis of continuous seismic profiling records revealed that these deformations are usually registered under local nonuniformities of sedimentary layers, such as: reef and salt masses, morainal ridges, karst cavities and erosional valleys buried beneath Quaternary deposits. These differ from the surrounding rocks with respect to both lithological composition and physical properties. The article gives a solution of the direct and inverse problems in continuous seismic profiling for the seismogeological conditions of the Baltic Sea. The presence of nonuniformities of the type mentioned above was revealed and their role in distorting the seismic record is clarified. A knowledge of the nature of deformations makes it possible to define disruptions of the layered structure caused only by tectonic factors and to avoid pitfalls in interpretation such as have occurred in such work on the land, where, for example, such formations have in the past been interpreted as local uplifts promising for petroleum and gas, whereas drilling failed to confirm the presence of such uplifts. Figures 3; references 19: 16 Russian, 3 Western.
[243-5303]

EXPERIENCE IN REGISTRY OF VERTICAL MICROSTRUCTURE OF TEMPERATURE AND CONDUCTIVITY
IN OCEAN SURFACE LAYER USING FLOATING-UP PROBE

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[Abstract] Experimental study of physical processes near the free surface of the
ocean are difficult using standard oceanological probes. The floating-up probe
("emergent sounder") has been developed for such purposes (N. V. Vershinskiy, et
al., "Probe for Investigating the Ocean Surface Layer," OKEANOLOGIYA, Vol 17, No 2,
1977). Since its introduction it has been supplemented with a second measurement
channel and the electronic circuitry of the sensors has been improved. The probe
has been supplied with a low-inertia temperature sensor and a sensor for conductiv-
ity micropulsations. This variant has been tested and used in investigating the
vertical microstructure of the thin ocean surface layer under the programs
"JASIN-78" and FGGE-79. A block diagram of the temperature measurement channel is
shown as Fig. 1 with 17 components identified; this figure serves as a basis for a
detailed description of its functioning. The use of this probe, having transducers
with a high spatial resolution, made it possible to obtain new data on the micro-
structure of the thin water layer close to the ocean surface. The calibration of
the conductivity meter is described, as well as a method for introducing necessary
corrections. A specific example of a surface layer sounding is given. The outfit
could be improved by adding a pressure (depth) sensor. It would be possible to
employ this method for measuring turbulent velocity fluctuations in the thin sur-
face layer. Figures 3; references 8: 6 Russian, 2 Western.
[243-5303]

DIGITAL INTEGRATING CURRENT AND TEMPERATURE METER

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[Abstract] The structure and operating principle for a new digital integrating cur-
rent and temperature meter are described. This instrument, known as the TsIITT,

represents a new version of similar complexes developed earlier with elimination of former inefficiencies and shortcomings. A circuit diagram accompanying the text is discussed. For measuring currents the instrument includes: a rotor-type velocity sensor, trigonometric unit with compass, storage element for latitudinal projections, storage element for meridional projections, counter of cycles, programming-timing unit, photorecorder and power unit, supplemented by a temperature sensor. In the temperature measurement channel the inertial properties of the sensor are used for smoothing fluctuations instead of averaging. The instrument is designed in the form of an insert in the housing of a BPV-2 current meter. The range of measurable current velocities is 3-228 cm.sec^{-1}; the relative error in measuring velocity is 1%; the range of measurable temperatures is 0-33°C; the discreteness of temperature registry is 0.03°C; the error in temperature measurement is $\pm$0.05°C; the principal registry period is 3 minutes; maximum operating depth is 1,000 m; period of self-contained operation is 20-40 hours. A consignment of these instruments was supplied for the Soviet-American POLIMODE experiment; these 200 instruments made possible the collection of new data on macroscale eddies in the ocean. Figures 4; references: 5 Russian.
[243-5303]

CURRENTS IN SOUTHERN RED SEA DURING WINTER

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[Abstract] On the 30th voyage of the scientific research vessel "Akademik Kurchatov" observations of currents were made during the period December 1979-January 1980 in the southern part of the Red Sea at approximately 18°N. The frequency of recurrence of winds of northerly directions in December was 72%, in January 55%; winds of southerly directions: in December 13%, in January 38%. Current measurements were made at three autonomous buoy stations with BPV-2 and TsIIT current meters with a discreteness of 30 and 12 minutes respectively. The measurements were made continuously for 23-25 days at the horizons 15, 75, 100, 200, 300 and 1,000 m. Other briefer observations were made. Measurements made in the Gulf of Aden at buoy and drift stations revealed transport in the direction of Bab-el-Mandeb Strait in the upper layer and an opposite flow in the deep layers. The analysis of these direct observations of currents, with allowance for background hydrometeorological characteristics, made it possible to draw the following

conclusions: 1) In the winter of 1979/1980 the currents in the southern part of the Red Sea for the most part corresponded to existing concepts. 2) In the central and western part of the investigated region the current in the surface layer was determined by changes in the wind field. In the central part, at a depth of 200 m, there was a density outflow from the Gulf of Aden. In the western part there was an intensification of the density compensation current from the Red Sea at the 1,000-m horizon with a change in wind direction from northerly to southerly. A velocity increase was accompanied by an intensification of semidiurnal tidal oscillations. 3) The current velocity spectra gave significant energy maxima in the inertial period (39 hours) and in tidal diurnal (24 hours) and semidiurnal (12.4 hours) periods. Figures 4, tables 1; references 6: 5 Russian, 1 Western. [243-5303]

INTERRELATIONSHIP OF FINE STRUCTURE, INTERNAL WAVES AND SMALL-SCALE TURBULENCE

DYKMAN, V. Z. and KISELEVA, O. A., Marine Hydrophysical Institute, Ukrainian Academy of Sciences

[Abstract] The results of experimental investigations of the process of energy supply of small-scale turbulence and its interrelationship to the field of internal waves are presented. These studies were made within the framework of the POLIMODE program. The apparatus employed, probes sliding along cables, measured the temperature of sea water with a response of 10^{-3}°C and a spatial resolution of 3.6 cm. The averaged profiles of temperature, salinity and density were obtained by synchronous soundings with the ISTOK hydrological probe. These investigations of the small-scale vertical structure of the temperature field were made in the Sargasso Sea, where anticyclonic and cyclonic eddies were observed at different times. The most detailed survey with a 15-km interval to a depth of 1,000 m was made during the 7th voyage of the "Akademik Vernadskiy" in the zone of a cyclonic eddy. In order to evaluate the influence of eddy formations on small-scale fluctuation processes an analysis was made of the quasihomogeneous layers 280-450 and 550-800 m. Since at present there is a difference of opinion concerning fine structure and microstructure, an attempt is made to clarify this problem. It seems clear that in the open ocean, outside of zones of mixing of waters of different origin, the main role in the formation of fine structure is played by internal waves. A detailed analysis of the experimental data revealed that there is a close correlation between the rate of influx of kinetic energy to turbulence, the density of potential energy of internal waves and local hydrological conditions. High values of the influx of kinetic energy correspond to lesser potential energy values but with an increase in

the mean Väisälä-Brent frequency there is an increase in the energy influx to turbulence and a decrease in the potential energy of interval waves. With an increase in the mean Väisälä-Brent frequency in the presence of a fine vertical structure there is an increase in the probability of appearance of local shear instability in interlayers. This should result in an increase in cases of destruction of unstable internal waves, accompanied by formation of "spots" of small-scale turbulence, and in general, an increase in the outflow of energy from internal waves to turbulence. This, in turn, can be one of the mechanisms for limiting the amplitude of internal waves, and accordingly, the potential energy of the wave field. The dependence of the rate of influx of kinetic energy and the potential energy value on the mean Väisälä-Brent frequency is most clearly manifested in layers with high density gradients, as is characteristic for the seasonal thermocline and zones of deformation of the density field in eddy formations. Figures 5, tables 1; references 18: 11 Russian, 7 Western.
[243-5303]

GENESIS OF FINE STRUCTURAL FEATURES OF OCEAN THERMOCLINE

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[Abstract] A study was made of the possibility of the appearance of fine structural features in the thermocline as a result of turbulent mixing caused by current velocity shear. On the 22d voyage of the scientific research vessel "Dmitriy Mendeleyev" in a polygon to the south of Sumatra data were obtained on the fine vertical structure of the temperature field and microscale fluctuations of current velocity using a freely falling probe. Many of the results of this work were given in earlier studies (V. S. Belyayev, IZV. AN SSSR: FIZIKA ATMOSFERY I OKEANA, Vol 17, No 8, 1981; V. S. Belyayev, et al., OKEANOLOGIYA, Vol 21, No 2, 1981), which provide background data for this article. An analysis of the data revealed that the formation of the quasiisothermal layer in the upper part of the thermocline is related to turbulent mixing as a result of current shear instability. An estimate of the rate of viscous dissipation of energy in the ocean is made using the equation for the balance of turbulent energy. The experimental data presented here confirm the idea that layers with a thickness of about 10 m in the oceanic thermocline which are characterized by a well-developed microstructure of hydrophysical fields are a result of the generation of microscale turbulence by a shear of mean current velocity. The vertical scale of such layers is evidently determined by the scales of inhomogeneities of the mean field of current velocity.

Their internal structure can be influenced considerably by density stratification of the water, limiting the vertical dimensions of individual turbulent formations. Figures 2; references 9: 6 Russian, 3 Western.
[243-5303]

HORIZONTAL VARIABILITY OF FINE THERMAL STRUCTURE OF WATERS IN OCEAN THERMOCLINE

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[Abstract] The article gives the results of statistical measurements of $T(z)$ profiles made on the 22d voyage of the scientific research vessel "Dmitriy Mendeleyev" with a freely sliding probe at 11 stations in the Indian Ocean to the south of Sumatra. The entire survey (minipolygon) was made in 30 hours; the mean distance between stations was 5 miles (minimum 3, maximum 11 miles). Use of the freely sliding probe made it possible to obtain vertical $T(z)$ profiles with a depth discreteness 0.33 m free of the distorting influence of the ship's rolling. It was found that in this small ocean area (15 x 17 miles) the statistical characteristics of the fine structure of the $T(z)$ profiles are spatially nonuniform. Over the greater part of the minipolygon the horizontal dimensions of the temperature inhomogeneities with vertical scales up to 17 m did not exceed the minimum distance between stations (4 miles), whereas in the zone of the postulated influence of the thermocline a nonzero coherency of the $T_z(z)$ profiles was observed at distances greater than 6 miles. For this zone the authors obtained spectra of the vertical structure of the horizontal temperature gradients, which it is proposed be approximated by the power-law dependence $S_{TL}(k) \sim x_z^2 \tau_z^{-1} k^{-2}$, where the X_z parameter describes the influence of horizontal advection and τ_z is the vertical flux of momentum. Figures 2, tables 2; references 7: 6 Russian, 1 Western.
[243-5303]

SPECTRAL STRUCTURE FEATURES OF MESOSCALE TEMPERATURE INHOMOGENEITIES IN TROPICAL
OCEAN ZONE

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[Abstract] The authors characterize some features of the spectral structure of the
temperature field in the surface layers of the ocean in tropical regions (in the
range of spatial scales from 1 m to 400 km). Water temperature measurements were
made from scientific research ships ("Mikhail Lomonosov" and "Akademik Vernadskiy")
using a towed thermistor sensor. The sensor was extended out from the ships into
the undisturbed zone and submerged to a depth of 1-3 m (some measurements were made
in the surface 25 cm). The temperature response of the detector was 10^{-3}°C and the
time constants of the sensors varied in dependence on the scale of the studied
inhomogeneities from 0.2 to 10 sec. Temperature measurements were accompanied by
meteorological observations and determinations of total solar radiation. The
spectral density functions were determined for mesoscale inhomogeneities in the
temperature field. It was found that the slope of the spectral curves varies both
from region to region and as a function of the considered interval of scales of
inhomogeneities. The levels of these spectra are usually higher in the coastal
regions of the ocean. The scatter of levels for temperature inhomogeneities in the
water surface layer with scales of tens-hundreds of meters is governed for the most
part by the diurnal variation of thermal processes in the ocean. In the deep
layers of the ocean there is an alternation of zones of intensive internal waves and
zones with a turbulent character of temperature field variations. Figures 5;
references 7: 6 Russian, 1 Western.
[243-5303]

GENERATION OF CAPILLARY-GRAVITATIONAL WAVES BY STEEP GRAVITATIONAL WAVES

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[Abstract] One of the possible mechanisms for the excitation of ripples (capillary-gravitational waves) is their generation on the crests of steep gravitational waves. This effect can also lead to a nonlinear limitation of the amplitude of gravitational waves excited by the wind or sound. The authors therefore felt it important to determine the characteristics of waves excited at the crest, their distribution in the gravitational wave, and compute the nonlinear decrement of a long wave associated with the excitation of capillary-gravitational waves. In the article ripples are therefore regarded as capillary-gravitational and it is shown that allowance for this circumstance leads not only to quantitative, but also qualitative changes in the dependence of the parameters of ripples on the steepness of the gravitational wave and the nonlinear decrement of this wave, associated with the excitation of ripples. In particular, with an increase in the amplitude of the gravitational wave the steepness of the ripples increases, not so much due to a decrease in the radius of curvature at the peak as due to a rapid decrease in the group velocity of the capillary-gravitational waves excited at the peak. It is shown that the attenuation of ripples in the excitation region can also exert an influence on their amplitudes and allowance for the surface slope of the gravitational wave exerts no significant influence on the ripple characteristics.
Figures 4; references 11: 3 Russian, 8 Western.
[223-5303]

RADIATION REGIME THEORY FOR NEAR-IR SPECTRAL REGION FOR SEA SURFACE COVERED BY PETROLEUM FILM

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[Abstract] A study was made of the optical properties of a thin absorbing film situated between two media, of which one is a dielectric and the other an absorbing medium. Formulas are derived for computing the reflectivity and absorptivity of the absorbing film--absorbing underlying layer and for determining the vertical profile

of absorbed energy in the film and in the underlying layer. The developed method was then used in studying the influence of a petroleum film on the sea surface on the reflection and absorption of direct solar radiation in the range 2.27-3.00 μm. Estimates were made of radiation heating of the film and the underlying water for cases of heavy and light Baku petroleum for different solar zenith angles due to the absorption of radiation in the mentioned range. The results of this study, containing information for only a small part of the IR spectrum, do not give a full answer to the question of formation of the temperature regime of a sea surface covered by a petroleum film. This requires not only an examination of the entire flux of solar energy and effective radiation of the sea surface, but also an allowance for the convective-turbulent transfer of heat, evaporation, characteristics of waves and other factors exerting an influence on the temperature of the surface water layer. Figures 5, tables 3; references 20: 17 Russian, 3 Western.
[223-5303]

SOME PECULIARITIES IN FORMATION OF SHELF IMAGE IN OBSERVATIONS THROUGH WAVE-COVERED SEA SURFACE

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[Abstract] The quality of the shelf image observed through a water layer and the wave-covered surface is determined by the combined effect of several factors. The most important of these are the scattering and absorption of the light field in the water layer and its random refraction at the wave-covered air-water discontinuity. Although the literature gives data on the influence of the wave-covered discontinuity on the visibility of the shelf, no allowance has been made for scattering in the water layer between the bottom and the surface. For this reason the authors have derived fundamental expressions describing the dependence of the formed image on the joint influence of two factors: scattering in the water layer and refraction at the wave-covered discontinuity. The problem is formulated as follows. Assume that the bottom of a water body with the depth L is illuminated by a light source S situated at the height z_S over the mean level of the discontinuity. The position of the source in the horizontal plane is characterized by the vector r_S and its directional diagram has a maximum in the direction n_S. The receiver registering the radiation reflected by the bottom is described by similar parameters z_R, r_R, n_R. Proceeding on the basis of this scheme, it was possible to find for the optical transfer function determining the structure of the averaged image the conditions under which it can be broken down into the product of the optical transfer functions for the observation instrument, water layer and wave-covered surface.
References: 7 Russian.
[223-5303]

REMOTE RADIOMETRIC INVESTIGATIONS OF ATMOSPHERE IN DEVELOPMENT ZONE OF TROPICAL CYCLONES

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[Abstract] The article gives the results of multisided radiometric investigations of the meteorological parameters of the tropical atmosphere carried out on the scientific research ship "Akademik Korolev" under the international expedition "Tayfun-78." Experimental data are given on the temporal and spatial variations of atmospheric meteorological parameters in the zone of generation of typhoons. The results are compared with the development of synoptic conditions in the investigated region. It was found that there is an increase in the total mass of water vapor and its temporal variations in the peripheral zone of a typhoon in the stage of its generation. The method for studying the atmosphere in the zone of development of tropical cyclones involved measurement of the meteorological parameters in the undisturbed atmosphere and in the presence of a disturbance with their subsequent comparison. The results presented here are based on a statistical analysis of the principal meteorological parameters of the undisturbed tropical atmosphere in the northwestern part of the equatorial Pacific (region of the maximum frequency of recurrence of tropical cyclones). The radiometric measurements of the tropical atmosphere with subsequent determination of the vertical temperature profile $T(h)$, the total mass of water vapor and total liquid-water content of clouds were made in the absorption bands of oxygen and water vapor and in the atmospheric transparency windows 6 and 8 mm. Figures 6; references 14: 11 Russian, 3 Western.
[223-5303]

EXPEDITIONARY INVESTIGATIONS ON 38th VOYAGE OF SCIENTIFIC RESEARCH VESSEL 'MIKHAIL LOMONOSOV'

BULGAKOV, N. P., KOVESHNIKOV, L. A. and MIKHAYLOV, E. A.

[Abstract] The 38th voyage of the "Mikhail Lomonosov" took place during the period 17 October 1979 - 28 February 1980, partly in the Caribbean Sea and partly on the continental slope off the Guinea Republic. The principal objectives of this

expedition were: 1) study of the background hydrophysical, hydrochemical and hydrobiological fields; 2) investigation of the thermohaline and hydrochemical structure of these waters and its variability; 3) instrumental measurement of currents and study of the kinematic structure of waters; 4) determination of the parameters of inertial, tidal and short-period internal waves; 5) determination of regions of vertical movements of waters; 6) study of the optical characteristics of water masses, determination of their vertical and horizontal structure; 7) investigation of the composition and quantitative characteristics of biological indices and their spatial and temporal variability; 8) carrying out methodological work with a new automatic bathometer. Other work included standard and special meteorological observations, measurements of the index of attenuation of radiation and water temperature while the ship war proceeding on course, study of the strength properties of glass spheres and investigation of the influence of a marine tropical climate on the properties of new materials and the performance of objects fabricated from them. The measurements were made in polygons situated in the central part of the Caribbean Sea and off West Africa (Figure 1 is a map of the ship's track and the location of these polygons; Figure 2 is a detailed map of the work in the Caribbean Sea; Figure 3 is a corresponding map for the work off the African coast). The 60 scientific specialists on these expeditions represented the Marine Hydrophysical Institute, Institute of Biology of the Southern Seas, Moscow Physical Engineering Institute, Institute of Organic Chemistry, and others. Investigations on the shelf regions of the Atlantic Ocean off the coast of West Africa were made for the purpose of studying natural resources and were closely tied in to the work program for the scientific center established in the Guinea Republic. For example, four runs were made in this area which intersected the principal macroscale elements of water circulation in this region. The distance between the runs was 30 miles and the distance between stations was 10-20 miles. The ocean floor here was found to have a complex relief. The principal water masses were defined. A zone of coastal upwelling was precisely delineated; temperature and salinity inversions were discovered in the polygon at depths of 220-450 m. The complex structure of hydrochemical fields is attributable to the dynamics of the waters in the area and the intensity of transpiring biochemical processes. Data were obtained on the concentrations of organic carbon, krypton-85, tritium, dissolved hydrogen and other elements. Similar measurements were made in the Caribbean area and are briefly described, with emphasis on the work done near Grenada. Figures 3.

[229-5303]

INVESTIGATING RED SEA FLOOR BY PHOTOTELEVISION SYSTEMS

YASTREBOV, V. S., SAGALEVICH, A. M. and ONISHCHENKO, E. L., Institute of
Oceanology, USSR Academy of Sciences

[Abstract] The results of investigations of the Red Sea floor using photographic
and television systems carried in manned, telecontrolled and towed vehicles are pre-
sented. The article describes investigations. of the Red Sea rift zone made during
the 30th voyage of the research ship "Akademik Kurchatov" and the 3d voyage of the
research ship "Akvanavt" which carried the underwater vehicles "Paysis-XI,"
"Zvuk-4," "Zvuk-4m," "Zvuk-6" and "Manta-1.5." The mission of the "Paysis-XI" was
concentrated on search for and investigation of regions of recent volcanism, spread-
ing zones and outcrops of evaporites. The towed vehicles "Zvuk-4," "Zvuk-4m" and
"Zvuk-6" were used in studying the geology of regions covered with sediments and
especially study of numerous openings and hilly formations discovered in the surface
sediments. Also employed in the same part of this polygon was the telecontrolled
"Manta-1.5," whose manipulator took bottom samples in the region of the discovered
openings. The "Paysis" is particularly effective in studies of local regions on the
bottom with dissected relief and floor formations can be investigated by making
prolonged stops or by hovering. The "Zvuk" vehicles are most effective when towed
over a great distance over a period of many hours, but difficulties are encountered
when they are towed over highly dissected terrain. The "Manta-1.5" has advantages
when it is necessary to make prolonged detailed investigations of the floor with
the taking of samples. In all parts of the polygon the underwater vehicles, which
covered a distance of 164 km near the bottom, obtained much factual material in the
form of photographs (3,240 photographs) and videorecordings of television images
(16.5 hours). Whereas the television information obtained by the "Paysis" is only
a record of the events observed directly before the window, the videoinformation
obtained by the "Zvuk" and "Manta" vehicles provides dynamic information on the
observed situations. These observations made it possible to draw significant scien-
tific conclusions, some of which are discussed here. The new information relates to
bottom topography, behavior of fish and geological structure of the rift zone. The
expeditionary results indicated the high effectiveness of phototelevision surveys,
especially in combination with the combined use of several types of underwater
vehicles. Figures 3.
[229-5303]

USING IPF-70 FLUOROMETER-PROBE IN TOWED VARIANT

KARABASHEV, G. S. and SOLOV'YEV, A. N., Atlantic Division, Institute of Oceanology,
USSR Academy of Sciences

[Abstract] The IPF-70 fluorometer-probe has been used in detecting and investigat-
ing a number of patterns of variability of the fluorescence of chlorophyll and
dissolved organic matter in the ocean. However, this instrument was intended only
for vertical sounding from a drifting ship and therefore has been ill-suited for
investigating the mesoscale variability of the optical properties of the active
layer of the ocean while the ship is proceeding on course. Accordingly, the IPF-70
has now been modified so that it can be towed and test measurements were made of
the fluorescence of chlorophyll during ship movement during the 7th voyage of the
scientific research ship "Shel'f" in August 1979 in the Baltic Sea. The fluoro-
meter has been placed in a durable, compact, massive, streamlined shell for improv-
ing the hydrodynamic quality of the submergible part, reducing the vibration level
and providing protection against mechanical damage. The fluorometer is connected
to on-board instrumentation by a multistrand supporting-electrical cable. The
fluorometer is illustrated in Fig. 1 (10 components are identified); the carrier
used is a hollow body fabricated from welded steel plate, 150 cm in length and with
a maximum diameter of 40 cm. During movement of the ship at a speed of 5-6 knots
the carrier descends to the horizon 60-70 m when the length of the let-out cable
does not exceed 140-150 m. The interval of working depths of the carrier and probe
can be increased to 100-150 m with an increase in the mass of the carrier (for
which there is a free space in its prow compartment) and with full letting-out of
the cable (385 m). Figures 2, references 8: 6 Russian, 2 Western.
[229-5303]

SPECTRAL BRIGHTNESS COEFFICIENT OF WATERS IN SOME REGIONS OF PACIFIC OCEAN

KHALEMSKIY, E. N., Institute of Oceanology, USSR Academy of Sciences

[Abstract] The objective of this study was a determination of characteristic back-
ground values and curves of spectral distribution of the brightness coefficient for
different parts of the Pacific Ocean on the basis of expeditionary data collected

by specialists of the Institute of Oceanology. The σ_λ measurements were made using a visual FM-46 hydrophotometer in six parts of the visible spectrum (from 465 to 630 nm) in the range 10^{-4}-10^{-1} with a relative error not greater than 10%. The σ_λ values used in this study were measured at the nadir with illumination of the sea surface by mixed radiation. The paper is limited to a qualitative analysis of the data obtained in one region and in one climatic season; the results are given in a table and in a figure. Directly at the equator in the zone of the equatorial divergence the waters are enriched with suspended organic matter and for this reason there is increased scattering and absorption of light, especially in the blue part of the spectrum. To the north and south of the equator the content of organic matter decreases and the σ_λ values increase in the blue part of the spectrum. With increasing distance from the equator the content of suspended matter in the waters of the South Trades Current becomes increasingly less, as is manifested in an increase in the values of the brightness coefficient in the blue-green part of the spectrum. This tendency persists to the south as well--with transition to the purer waters of the southern subtropical convergence, and to the north--with transition to the waters of the North Trades Current and the northern subtropical convergence. The waters of the convergences contain a minimum quantity of organic and mineral suspension, are the purest in the ocean and the bluest. Data on the brightness coefficient were compared with data on light scattering. It was found that the relative change in the two characteristics with latitude occurs completely identically, indicating that the change in e brightness coefficient in the middle part of the spectrum is related to the change in the scattering index of these waters, not the absorption index, which in this part of the spectrum virtually does not change. Figures 1, tables 2; references 5: 4 Russian, 1 Western.
[229-5303]

INVESTIGATING ENERGY OF INTERNAL WAVES IN SYNOPTIC EDDIES USING TEMPERATURE FIELD STRUCTURE

DYKMAN, V. Z., KISELEV, O. A. and YEFREMOV, O. I., Marine Hydrophysical Institute, Ukrainian Academy of Sciences

[Abstract] Within the framework of the POLIMODE program on four expeditionary voyages on the research vessel "Akademik Vernadskiy" specialists carried out investigations of internal waves in zones where eddy formations are present and in zones of "background" conditions. By the term "background" the authors mean the mean hydrological conditions in a polygon in the absence of eddies or at points sufficiently distant from them. The energy characteristics of the wave field were studied using data on the fine structure of the vertical profiles, whose reversible

deformation is one of the manifestations of internal waves in the ocean. Investigations of the fine vertical structure were made using probes which measured temperature with a resolution of 0.001°C and with a depth discreteness of 3.6 cm. The averaged data on temperature, salinity and density were obtained using the results of synchronous soundings with the ISTOK hydrological probe. The research method involved soundings at drifting stations laid out in a uniform grid with an interval of about 15 miles in micropolygons situated in the zone of eddy formations. The normalized dispersions of vertical displacements σ_ξ^2 were computed in the range of normalized wave numbers γ from 0.1 to 1 cycle/m for all stations for two layers (280-405 m, 550-800 m). The values of the local Väisälä-Brent frequencies were obtained by synchronous soundings with the ISTOK. The following picture is given for the distribution of the density of potential energy of internal waves over the area of the eddy in the layer 280-405 m. The energy increases from the background values quite smoothly, already beginning with the distant periphery of the eddy and attaining maximum values (5-6 times greater than in the background) at its boundary, determined on the basis of hydrological data. At the center of the eddy the wave energy decreases sharply to the background level. The effective diameter of the eddy according to data on the intensity of internal waves is considerably greater than according to hydrological data. In the polygon there is usually some system of eddy formations and therefore their influence to one degree or another can be reflected in virtually the entire investigated region. Figures 4, tables 2, references 7: 3 Russian, 4 Western.
[229-5303]

UDC 551.465

ATTENUATION OF TURBULENCE IN A SPOT DURING ITS SPREADING IN STABLY STRATIFIED FLUID

BELYAYEV, V. S., Institute of Oceanology, USSR Academy of Sciences

[Abstract] In an earlier study (G. I. Barenblatt, IZV. AN SSSR: FIZIKA ATMOSFERY I OKEANA, Vol 14, No 2, pp 195-206, 1978) a model was formulated of the genesis and development of turbulent spots in a stably stratified fluid, with emphasis on study of the most prolonged viscous stage in the spreading of turbulent spots. The existence of pancakelike spots of turbulence in stably stratified layers is attributed to their intrusion into the surrounding medium. Therefore, a detailed investigation of the dynamics of turbulent spots in such a medium is of great importance for comprehending and explaining a broad class of phenomena in the real ocean. It was noted that there is a considerable slowing of the rate of increase in the horizontal dimensions of such an intruding spot with transition to the final viscous stage of its spreading. Expanding on this work, the author describes in

34

detail the evolution of the turbulence level in the viscous stage for axisymmetric and cylindrical spots. The turbulence parameters are estimated for both cases. In the considered model the characteristic lifetime T of turbulence in spreading spots in the viscous stage of their existence is much less than the characteristic time scales of change in the linear dimensions of the spots. However, the possible "external" velocity shear in the medium surrounding the spot is not taken into account. Allowance for this effect (inclusion of an additional source of generation of turbulence) can lead only to an increase in the lifetime of the turbulence in the spots. However, in the absence of an external current velocity shear in stably stratified layers of the ocean a predominance of pancakelike structures in which turbulence has already attenuated should be expected. Figures 1, tables 1, references: 6 Russian.
[229-5303]

ATLANTIC OCEAN DEEP WATER CIRCULATION

DEMIN, Yu. L. and MIKHAYLICHENKO, Yu. G., Institute of Oceanology, USSR Academy of Sciences

[Abstract] A study of the circulation of deep waters was made on a curvilinear surface of the maximum of a characteristic property of these waters (salinity). The investigation was limited to the Atlantic Ocean, whose deep circulation has been studied very poorly. The analysis assumes the existence of three types of deep water: North Atlantic and Atlantic deep waters and Mediterranean intermediate waters. The three-dimensional field of currents was computing using a quasi-geostrophic model. The principal characteristics of the movement of deep waters are analyzed and the patterns of their propagation in the Atlantic Ocean are outlined. The principal features of these circulations are shown in a series of figures: Fig. 1 shows currents (in $cm \cdot sec^{-1}$) at the surface of the deep salinity maximum; Fig. 2 shows the field of reduced pressure (in cm) at the surface of the deep salinity maximum; Fig. 3 shows the field of vertical velocities (in 10^{-5} $cm \cdot sec^{-1}$) at the surface of the deep salinity maximum. The following features stand out clearly: 1) A westerly boundary current of a southerly direction is clearly expressed; 2) In the northern parts of both basins (western and eastern) there are cyclonic circulations which extend in a meridional direction; 3) There is a westerly boundary current with southerly transport in the eastern basin (along the eastern slope of the Mid-Atlantic Ridge in the North Atlantic). The velocities of the westerly boundary currents in both basins are approximately identical and do not exceed several centimeters per second; 4) In the North and Central Atlantic there is a series of circulations of different magnitude and direction with an approximate

equality of the latitudinal and meridional transfers. In the depths of the western basin there is a powerful subtropical anticyclonic circulation; 5) There is a weakening (or absence) of the westerly boundary current in the western basin between 20°N and the equator; 6) South of the equator two major regions can be defined on the basis of the character of circulation: to the south and north of 30°S and in both basins this boundary corresponds to latitudinal rises of bottom relief; 7) south of 30°S in the western basin there is a series of powerful anticyclonic circulations which forms an easterly transfer on their southern peripheries. The macroscale features of circulation of deep waters agree rather well with the major relief features at the considered surface, this being especially characteristic for the Northwest Atlantic and the eastern basin of the South Atlantic. On the basis of data in the literature and other analytical materials it was possible to make estimates of the meridional transport of these deep waters. Figures 3; references 18: 6 Russian, 12 Western.
[229-5303]

UDC 551.465

SEASONAL VARIABILITY OF UPPER THERMOCLINE AND SELF-SIMILARITY OF TEMPERATURE PROFILES

Moscow OKEANOLOGIYA in Russian Vol 21, No 3, May-Jun 81 (manuscript received 14 Aug 78, after revision 3 Oct 80) pp 416-424

FILYUSHKIN, B. N. and MIROPOL'SKIY, Yu. Z., Institute of Oceanology, USSR Academy of Sciences

[Abstract] A one-dimensional model of the thermal structure of the active layer in the ocean is proposed. It is based on the assumption of a self-similarity of the heat transfer process in the seasonal thermocline (the existence of self-similarity is postulated for both temperature and the heat flow). It was found that this assumption is adequate for deriving a closed system of equations describing the temporal variability of active layer characteristics. The theory also describes hysteresis phenomena associated with the sinking and rising of the homogeneous layer, and for all stations the existence of self-similarity was checked relative to the temperature profiles separately for both deepening and rising of this layer. A comparison with observational data indicated that the model describes the experimental data well, is extremely simple and includes only a small number of parameters easily measured under oceanic conditions. The proposed description of the slow process of evolution of the seasonal thermocline does not explain its short-period fluctuations occurring during storms (a detailed theory is required for this purpose). With respect to the self-similarity hypothesis serving as the basis for the theory set forth here by the authors, it can be explained on the basis of the considerable difference in time scales of the processes transpiring in the homogeneous layer, seasonal thermocline and main thermocline. Still unclear is the local mechanism determining exchange processes in the seasonal thermocline. Figures 4, tables 1; references 15: 9 Russian, 6 Western.
[229-5303]

STABILITY OF VERTICAL DISTRIBUTIONS OF SUSPENSION AND HYDROOPTICAL CHARACTERISTICS
IN OCEAN SURFACE LAYER

VASIL'KOV, A. P., Institute of Oceanology, USSR Academy of Sciences

[Abstract] In an earlier study (V. I. Burenkov, et al., "Theoretical Model of the
Vertical Distribution of a Suspension and Hydrooptical Characteristics in the
Surface Layer of the Ocean," IZV. AN SSSR: FIZIKA ATMOSFERY I OKEANA, Vol 17, No 5,
1981) it was demonstrated that the considered model of the vertical distribution of
suspension in the ocean under definite conditions allows the existence of stationary
solutions. However, formally existing stationary solutions may be unstable and
therefore devoid of physical sense. The qualitative considerations and analysis
presented here give definite indications of the possibility of an instability of
stationary solutions in a case when irradiance at the surface exceeds the optimum
level for photosynthesis. The absence of a stable distribution of biological sus-
pension in this case results in a temporal variability of the vertical profiles of
hydrooptical characteristics even when all the conditions (hydrophysical, irradiance,
concentration of the biogenous element at the boundary of the photic zone) are
stationary. However, this conclusion must be applied with caution to the real
situation in the ocean. This is attributable primarily to the fact that in the used
theoretical model no allowance is made for a number of factors which may exert a
stabilizing influence on the profile of phytoplankton. References 2: 1 Russian,
1 Western.
[211-5303]

SLIGHTLY NONLINEAR INTERACTIONS OF ROSSBY WAVES IN BAROTROPIC OCEAN

REZNIK, G. M. and KOZLOV, O. V., Institute of Oceanology, USSR Academy of Sciences

[Abstract] The problem of nonlinear interactions of planetary waves is directly
related to important problems in the dynamics of synoptic disturbances. However,
such an important aspect of this problem as slightly nonlinear interactions has been
studied completely inadequately. The theory of such interactions is directly
applicable, for example, to barotropic Rossby waves in the ocean, having typical
phase velocities of about 1 m/sec and orbital velocities of about several cm/sec.

A problem of independent interest is that of energy transformations in systems of slightly interacting Rossby waves in relation to the general theory of turbulence on the β-plane. Accordingly, the authors studied the dependence of the spectral transfer caused by slightly nonlinear interactions on the form of the spectrum for Rossby waves. It was found that the tendency of a current to a zonal state is not a stable tendency and upon attaining an adequately high "degree of zonality" an increase in the meridional component of the current begins. It is shown that the spectrum, initially asymmetric with respect to wave numbers, tends to become symmetric relative to the k, ℓ axes. The article gives an analysis of the dependence of transfer intensity from the peak position and spectrum width on the presence or absence of a "solid cap" and other factors. Figures 2, tables 1; references 9: 2 Russian, 7 Western.
[211-5303]

VARIATIONAL-DIFFERENCE METHOD FOR SOLVING PROBLEMS IN THEORY OF TIDES AND CIRCULATIONS IN BAROCLINIC OCEAN

MARCHUK, G. I. and BUBNOV, M. A., State Committee on Science and Technology, USSR Council of Ministers, and Computation Center, Siberian Department, USSR Academy of Sciences

[Abstract] Recently the variational-difference method, widely employed in formulating difference schemes for the solution of different problems in mathematical physics, has been successfully employed in obtaining representative numerical models of tidal currents and macroscale circulations in the ocean (for example, see G. I. Marchuk, et al., "Finite Elements Method and Finite Differences in Problems of Global Oceanic Circulation," IZV. AN SSSR, FAO, Vol 11, No 12, 1975). Since the problems of dynamics of the ocean usually are nonclassical problems of mathematical physics, the need arises for investigating and validating the resulting variational-difference schemes. Accordingly, the article gives results obtained by the authors in formulating, validating and investigating iteration methods for solution in variational-difference schemes for problems of the dynamics of tides and circulations in basins with variable bottom relief. The methods and algorithms presented in the article were used in creating a numerical model of tidal currents in the world ocean with a real distribution of depths and shorelines within the framework of a baroclinic model. Figures 1; references: 16 Russian.
[211-5303]

EXPANSION OF MATRIX ELEMENTS FOR SCATTERING BY SEA WATER IN GENERALIZED SPHERICAL
FUNCTIONS

ZEGE, E. P. and CHAYKOVSKAYA, L. I., Physics Institute, Belorussian Academy of
Sciences

[Abstract] During recent years measurements of matrices of scattering by sea water
have been made in different oceans and at different depths. This has created a pos-
sibility for developing methods for making specific computations of the light fields
in the sea with polarization taken into account. Vector transfer theory is based on
a representation of elements of the scattering matrix in the form of certain expan-
sions in generalized spherical functions. The values of the expansion coefficients
enter into asymptotic formulas and analytical solutions and are also necessary for
the development of many numerical methods. The authors have developed a method for
computing the coefficients of expansion of elements of the scattering matrices in
generalized spherical functions which is convenient for processing the matrices of
scattering by sea water and clouds and expansions were made for some experimentally
measured matrices of scattering by sea water $\hat{a}(\mu)$ (μ is the cosine of the scatter-
ing angle). The study is limited to an examination of scattering matrices of the
simplest form, when $a_{13} = a_{14} = a_{23} = a_{24} = a_{31} = a_{32} = a_{41} = a_{42} = 0$, $a_{12} = a_{21}$,
$a_{34} = -a_{43}$ with $\hat{a}(\pi, \vec{n}_0) = \hat{a}(\hat{n} - \hat{n}_0)$. These conditions are characteristic for
media consisting of particles and their mirror reflections in different quantities
and with a random orientation. Experimental measurements show that in many cases
the optical properties of real media, especially sea water, are described quite well
by a scattering matrix in this approximation. The accuracy of the expanded functions
is discussed and the asymptotic behavior of the coefficients is investigated.
Figures 4, tables 2; references: 8 Russian, 2 Western.
[211-5303]

EXPERIMENTAL DETERMINATION OF SPATIAL-TEMPORAL PRESSURE CHANGES OVER SEA SURFACE IN PRESENCE OF WIND WAVES

GORSHKOV, N. F., Moscow State University

[Abstract] On the basis of detailed measurements of fluctuations of atmospheric pressure over the wave-covered sea surface the author gives the results of determination of the spectrum of fluctuations of atmospheric pressure for heights up to 20 m over the sea surface, its correlation with the spectrum of waves and the results of determination of some spatial scales of pressure change. The conditions for these measurements correspond to deep water, a sea depth of about 40 m (platform in the Caspian Sea, 40 km from shore, not far from Baku). The registry apparatus was on a mast mounted on the bottom with a platform at a height of 12 m above the sea level. Measurements of atmospheric pressure were made with two types of sensors of the capacitor type and a wave recorder was at a distance of 3.6 m from each pressure sensor. At the time of measurements the pressure sensors were extended 20 m beyond the platform and when studying pressure fluctuations as a function of height above the sea surface they were suspended on a cable from the edge of the platform. The minimum heights of the pressure sensors above the sea was 1.5 m and the maximum height was 20 m. The spectra were determined by the fast Fourier transform method. A comparison of the results of measurements of the pressure spectrum and the wave spectrum (Fig. 1) reveals that the change in atmospheric pressure induced by a wave can have several spectral density maxima and as many as in the spectrum of waves. The increase in spectral density at the maxima relative to the spectral density at the near-lying frequencies is approximately identical for all the maxima in the pressure spectrum, whereas in the spectrum of waves one of the spectral density maxima almost always exceeds the others. This fact is evidence that when the surface of the fluid is exposed to atmospheric pressure disturbances of equal intensity, but different frequency, the rise of the fluid surface is maximum at frequencies close to the characteristic frequency of gravitational oscillations of the fluid surface, that is, is evidence of the presence of resonance at the frequency of the waves. It was found that there is an interaction of waves with air layers whose height is dependent on frequency: the lower the frequency of the wave component, the higher is the air layer with which this component interacts. On the basis of the one-dimensional spectrum of fluctuations of atmospheric pressure it is also possible to compute the spatial spectrum, assuming an isotropicity of the fluctuations of atmospheric pressure on a plane (two-dimensional spectrum) or in space (three-dimensional spectrum). Figures 3, tables 2; references 13: 9 Russian, 4 Western.
[211-5303]

UNDERWATER INVESTIGATIONS OF KALAMITSKOYE FIELD OF CONCRETIONS USING DEEP-WATER VEHICLE

GEVORK'YAN, V. Kh., PAVLOV, A. V., MITIN, L. I., PROTVINA, G. N., LEY, L. G., ZIMOGLYADOV, V. A. and MURCHENKO, L. G., Institute of Geological Sciences, Ukrainian Academy of Sciences

[Abstract] In order to evaluate the prospects for finding ores on the shelf of the Black Sea, during May-June 1979 a detailed study was made of the central part of the Kalamitskoye field of ferromanganese concretions in the western part of Kalamitskiy Gulf in the Crimea from an underwater vehicle (whose description is not given here). Direct observations of the bottom surface indicated that the relief of the Kalamitskoye field is not a level plateau, but instead an alternation of gentle ridges with a bottom relief up to 1 m; the distances between depressions and rises do not exceed 3-5 m. The surface layer of sediments is characterized by a microrelief consisting of ripples and folds, evidence of action of bottom currents. The surface sediments are represented by clayey, clayey-silty oozes of a bluish-gray, light gray and dark greenish-gray color with an insignificant admixture of shell detritus. The light-colored varieties of oozes are associated with the uplifted sectors of the ridges; the darker varieties are associated with troughs and depressions. On the surface of the light gray oozes there are black scattered spots of matter of a semifluid consistency representing local manifestations of surface hydrogen sulfide contamination of the bottom; these spots measure from 10-15 cm to 1.5 m. A sonar survey revealed the presence of large boulders with some of the latter up to 3 m in diameter. Concretions in the surface layer are in the form of elongated black inclusions against the light-colored background of the clayey oozes. These concretions are more than half embedded in the ooze. For the most part the concretions measure 2-3 cm, although there are individual formations measuring up to 15 cm. The ferromanganese matter is concentrated primarily on the marginal parts of shells and has a dark color; on large shells there is a one-sided concentration of concretion substance. Visual observations show that the distribution of concretions is nonuniform. They are associated with light-colored clayey bands and are not found at all in the darker varieties of sediments. This investigation confirms the effectiveness of use of deep-water vehicles for studying a variety of geological formations. No other means of research yields so much information on microrelief structures and their spatial orientation. Figures 1; references: 1 Russian.
[221-5303]

TERRESTRIAL GEOPHYSICS

NEW SUPER-DEEP DRILLING PLANNED

Leningrad LENINGRADSKAYA PRAVDA in Russian 14 Jun 81 p 4

[Excerpt] In the near future super-deep drilling will be undertaken in the Urals,
Caucasus, and also in the Tyumen' Oblast. During the drilling, practical work
associated with the search for new and deep oil and gas deposits will be conducted.
At the same time, the construction of thick, folded systems, seismically active
regions, and relatively young volcanic areas within the earth's crust will be
investigated using super-deep drilling. The opportunities for using the earth's
deep heat in industry and at home will be evaluated. However, the search for
deposits of different mineral resources is the chief task.

CSO: 1865/232-P

ALGORITHM FOR NUMERICAL SOLUTION OF BOUNDARY VALUE PROBLEM OF FLEXURE OF PLATES
WITH ANGLE POINTS

ASADOV, F., Mathematical Institute and Computation Center, Tajik Academy of
Sciences

[Abstract] In earlier studies (DOKL. AN TadzhSSR, Vol 10, No 7, 10-12, 1967;
Vol 11, No 8, 6-9, 1968) the author employed the A. A. Dorodnitsyn method in solving
the boundary value problem of the flexure of rectangular ($0 \leqslant x < a$, $0 \leqslant y \leqslant b$) plates of a
constant thickness when the edges are rigidly sealed. The solution of the problem
was represented in the form of infinite double trigonometric Fourier series and
convergence of the method was numerically investigated. Proceeding on the basis of
this earlier work, the author now has obtained a numerical solution of the boundary
value problem of flexure of nonrectangular angled plates (triangular, trapezoidal,
quarter-circles, ellipses, etc.) of constant thickness when the edges of the plates
are rigidly sealed. The flexure of plates of a constant thickness is described by
a biharmonic equation

$$\Delta\Delta \, \varphi(x, y) = P)x,y)/D, \qquad (1)$$

where $\varphi(x, y)$ is a flexure function, $P(x, y)$ is an arbitrary transverse load,
$D = Eh^3/12 \, (1 - \nu^2)$ is the flexural rigidity of the plate (E is the elastic modulus,
h is plate thickness, ν is the Poisson coefficient). At the rigidly sealed edges
the boundary value conditions have the form:

$$\varphi|\Gamma = 0, \quad \frac{\partial\varphi}{\partial n}\Big|_\Gamma = 0. \qquad (2)$$

Here n is the internal normal to the boundary Γ of the plate.
Using such examples as a right-angle triangle and an equilateral triangle, the
author develops a simple scheme for solution of the boundary-value problem (1)-(2).
Without significant modification it is also applicable for the differential equation
for flexure of plates of a variable thickness varying in conformity to the linear
law $D = D_0 + D_1 y$. References: 5 Russian.
[241-5303]

OPERATIONAL MONITORING OF DRILLING USING MINI- AND MICROCOMPUTERS

KRYLKOV, M. Yu., Moscow Geological Prospecting Institute

[Abstract] The development of mini- and microcomputers has afforded new possibili-
ties for the automation of drilling work. Many expeditions and field parties of the
RSFSR Geology Ministry have been supplied with such technology. The author proposes
creation of a decentralized automated system for the drilling of boreholes consist-
ing of two subsystems: the first, lower hierarchical level, with a microcomputer at
the hole site, and the second, higher level, with a minicomputer, at the field base.
At the lower level the following tasks would be performed: 1) collection and pre-
liminary processing of data received at the site for its transmission to the higher
level, 2) monitoring of the drilling process itself. The processing of data can be
easily organized during the raising and lowering of the tool; during this time the
microcomputer is capable of performing necessary analyses on whose basis recommenda-
tions can be made for the next drilling period. The plan for drilling of holes,
ranging from the choice of equipment and technical specifications of the tool to
computations of the optimum parameters of the drilling regime, can be worked out at
a stationary expeditionary center with a minicomputer. The author reviews the
essential operations, tests and analyses which the microcomputer would perform in
such a scheme. All the measured parameters would be compared with the data and
models in the microcomputer memory. The scheme was put to a practical test under
real geological and technical conditions and the highly effective results are des-
cribed. Figures 3, tables 2; references: 5 Russian.
[228-5303]

DISCRIMINATION OF DIFFRACTION ANOMALIES IN RADIO WAVE PROBING METHOD

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[Abstract] In geological radio wave probing it is common to employ "pure" anomaly
methods. In actuality, this approach has severe limitations. Diffraction anomalies
have a characteristic and complex form appreciably different from the form of random
interference and therefore in the discrimination of such anomalies it is possible to

apply the statistical theory of signal detection. For the diffraction measurement method there is a large number of nomograms which makes it possible to select a standard anomaly. The author has applied the inverse probability method (O. A. Demidovich, VYDELENIYE SLABYKH GEOFIZICHESKIKH ANOMALIY STATISTICHESKIM METODOM (Discrimination of Weak Geophysical Anomalies by a Statistical Method), Moscow, "Nedra," 1969), for the discrimination of diffraction anomalies at the edge of gently dipping ore strata against a background of random interference. The nomograms employed were obtained by an analysis of rigorous solution of the problem of diffraction of spherical electromagnetic waves in the presence of a horizontal ideally conducting half-plane. The method is applied to specific records obtained in the field. The experimental data and analysis presented here demonstrate the validity of the inverse probability method for discriminating diffraction anomalies against a background of intense random noise. Since in the diffraction measurement method the interference is usually not correlated, this makes it possible to employ quite simple formulas in computing the probability. Figures 2, tables 3; references: 7 Russian.
[228-5303]

UDC 550.834

STUDYING EFFECT OF CAVERNS ON ELASTIC WAVE ATTENUATION BY MATHEMATICAL MODELING METHOD

DZEBAN', I. P. and DASAYEV, Ya. Kh., All-Union Scientific Research Institute of Nuclear Geology and Geophysics

[Abstract] The problem of discriminating rocks with secondary porosity (such as caverns) is extremely timely in petroleum and gas exploration work and geological engineering. Wide-band acoustic logging is a promising method for its solution. It is based on registry of the parameters of different types of elastic waves. The coefficients of attenuation of elastic waves are especially sensitive to caverns. The attenuation of elastic waves by caverns has not been adequately studied. Accordingly, the authors investigated this problem by computing the coefficients of attenuation of longitudinal α_p and transverse α_s elastic waves. The expressions used were for a medium containing cylindrical cavities of infinite length and finite radius, oriented perpendicular to the direction of elastic wave propagation. Such a medium with respect to its elastic properties virtually does not differ from a medium containing spherical voids. Attenuation in a medium with caverns is caused for the most part by the scattering of harmonic waves. The scattering of an elastic wave occurs when its length exceeds the dimension of the cavern. The parameters used in the computations were: cavern radius 0.1-2.0 cm; frequency -- 10 KHz. In the text Fig. 1 shows curves of the attenuation of a longitudinal wave;

Fig. 2 represents attenuation of transverse waves. These curves were plotted as a function of the volumetric content of coverns (1, 5, 10, 15%) (K_{cav} coefficient). The α_p and α_s values increase with an increase in K_{cav}, the radius of the caverns and the frequency of the elastic waves in conformity to rather sharply expressed curvilinear dependences indicating a great sensitivity of the amplitude parameters of both types of waves to the K_{cav} value. A model experiment was also carried out. Both the computations and the experiment revealed an approximately identical attenuation of longitudinal and transverse waves by caverns. Figures 3; references 4: 3 Russian, 1 Western.
[228-5303]

THEORY OF CARTOGRAPHIC PROJECTIONS

TOLSTOVA, T. I.

[Abstract] The author examines a class of cartographic projections whose grid is symmetric relative to a central linear meridian and with parallels having the form of ellipses. This case is of interest because it generalizes projections with circular and straight parallels, and this makes it possible to reveal the analytical relationships among all the classical projections and at the same time obtain new projections of practical importance. In the examined class of projections with elliptical parallels it is possible to discriminate four limiting classes with extreme h and α values (h is a parameter determining the relationship of the ellipse semi-axes a and b, α is the coefficient of proportionality of longitudes). With $h = 1$ there is a class of projections with circular parallels; with $h \rightarrow \infty$ there are projections with straight parallels (case of a greatly elongated ellipse); with $\alpha = 1$ a limiting class is obtained which includes all types of azimuthal projections with elliptical parallels; with $\alpha \rightarrow 0$ there are all types of cylindrical projections in which the parallels are straight. The properties of conic (and pseudoconical), polyconic (and polypseudoconical), cylindrical and azimuthal projections are examined. Projections of these types have the following characteristics: in all types of azimuthal projections distortions are absent (or extremal) at the pole point; in all types of conic projections distortions are absent (or extremal) at the central parallel; in all types of cylindrical projections distortions are absent (or extremal) at the equator. Thus, the author represents a full system of projections with elliptical parallels of interest for depicting the entire earth. As an example of the usefulness of a special case, an equal-area polypseudoazimuthal projection with elliptical parallels with a linear central meridian, in which distortions of lengths, angles and areas are absent, the equator is

represented by a straight line and both poles as points, it is shown that it is pos-
sible to give a good representation of the Pacific Ocean and its relationship to
other oceans. Such a variant can also be used for representing all four oceans
and for maps of the world. Figures 1, tables 4; references: 4 Russian.
[235-5303]

TWO-PENDULUM SEISMOMETER

ZHELEZNYAK, T. K., ZHELEZNYAK, L. K. and KIRNOS, D. P., Institute of Physics of the
Earth

[Abstract] The use of a galvanometer as a correcting element (integrator) in the
direct circuit of a seismic channel for broadening the frequency range is common in
seismometry. In this article the authors examine the use of a balanced pendulum
(galvanometer) as a correcting device (differentiator) in the feedback circuit of a
seismometer for increasing its characteristic period. In the proposed instrument
the seismometer has two mechanical oscillatory systems: the pendulum of the base
seismometer, which is the primary converter, and a balanced pendulum, used in
correcting the frequency characteristics of the instrument. Figure 1 in the text is
a circuit diagram for this two-pendulum seismometer; the diagram serves for a
theoretical and functional description of the instrument. The described system is
of the long-period type. In the absence of damping this two-pendulum seismometer
is a system with low-frequency free oscillations n_{s1} on which are superposed high-
frequency oscillations n_{s2} (nutations). Figure 2 shows a block diagram of a
channel with a two-pendulum seismometer; Fig. 3 shows the amplitude-frequency
characteristics of a channel with a two-pendulum seismometer. The actual working
model of the instrument is described. Its use confirmed the theoretical conclusion
which has been drawn that there is an increase in the characteristic period of the
system when employing a high frequency balanced pendulum in the feedback circuit of
the seismometer and revealed a high effective response of the system under condi-
tions of its low-quality siting. Figures 5; references: 3 Russian, 1 Western.
[206-5303]

INFLUENCE OF OCEAN AND MANTLE VISCOSITY ON EARTH'S NUTATION

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[Abstract] An analytical solution was found for the problem of the free movement of
the pole and nutation for a model of a gravitating earth with a homogeneous
incompressible core, an arbitrary viscoelastic mantle and an ocean. The author
examines in detail the mechanism of exchange of the moments of momenta between the
core and the mantle, with allowance for inelastic deformations of the core-mantle
boundary and a tide in the ocean. On the basis of a solution for a real model of
the mantle it was possible to compute the attenuation of free movement of the pole
caused by the viscosity of the mantle and energy dissipation in the ocean and also
the influence of the ocean on the amplitudes and phases of the forced nutation.
With allowance for energy dissipation in the ocean a study was made of resonance
excitation of annual nutation of the Ψ_1 wave in the distant past when the frequency
of this wave was close to resonance. Among the conclusions drawn were the follow-
ing. The influence of the ocean and mantle viscosity on free and forced nutation of
the earth is determined completely by the values of the parameters $\lambda_1, \ldots, \lambda_4$,
having the sense of effective rigidity of the mantle to the effect of surface and
volumetric forces distributed proportionally to a second-order spherical functions.
The decrement of attenuation of the free near-diurnal movement of the pole is com-
pletely determined by the $\mathrm{Im}\lambda_1$ parameter. The $\mathrm{Im}\lambda_1$ value is related to the secular
slowing of the earth's diurnal rotation by the K wave and to the distribution of the
dissipative function $Q_\mu(r)$ in the mantle. The time of attenuation of the free near-
diurnal movement of the pole due to energy dissipation in the ocean and the
inelastic mantle is about 300 years. The influence of the ocean tide on the elastic
earth tide leads to a decrease in the period of near-diurnal resonance by only 0.4
sec, which corresponds to a reduction in the period of free motion of the ω vector
in space by approximately one day. The corrections for the ocean to the amplitudes
and phases of the earth's forced nutation do not exceed the errors in modern
astronomical observations. References 29: 9 Russian, 20 Western.
[206-5303]

DEEP STRUCTURE OF KHANKAYSKIY COMPLEX

KOSYGIN, Yu. A., academician, MALYSHEV, Yu. F. and PETRISHCHEVSKIY, A. M., Institute of Tectonics and Geophysics, Far Eastern Scientific Center, USSR Academy of Sciences

[Abstract] The tectonic nature of the Khankayskiy complex has been differently interpreted by different researchers, some regarding it as a multilevel residual block of an ancient platform, and others considering it to be a region of early consolidation of the continental crust. Basic information on deep structure of the complex has been obtained from deep seismic sounding data which reveal a considerable seismic stratification of the crust (5-6 velocity horizons). Most of the layers are conformal and are traced into adjacent structural zones without a substantial change in velocity parameters and this has served as a basis for extending the basement of the Khankayskiy complex under the folded structures of the Sikhote-Alin. The authors have made a statistical investigation of the spatial distribution of the centers of gravitating masses, approximated by two types of objects: isometric and plane bodies. Isometric bodies are those satisfying the condition $Z_1 > 1/2d$ and plane bodies conform to the condition $Z_1 < 1/2d$, where Z_1 is depth to the surface of the body and d are horizontal dimensions of the body along the profile. There was found to be two types of dependence of the depth Z_0 of centers of masses on the width ΔX of gravity anomalies. For isometric bodies this dependence is described by the regression equation $Z_0 = 0.4\Delta X + a$ (a is the initial point on the Z_0 axis); for plane bodies Z_0 is virtually not dependent on ΔX. Bouguer anomalies were interpreted along a system of parallel profiles intersecting the Khankayskiy complex. The results of statistical computations are given in a figure and in a table. The data reveal that there are three levels of predominant positioning of the centers of mass of plane bodies: at depths of 5, 10 and 23 km. Maps of the spatial distribution of the plane bodies were plotted and the structural plans for the three levels are discussed in detail. The three deep levels (5, 10 and 20-25 km) differ sharply with respect to internal structure and spatial orientation of structural elements. Two major blocks can be discriminated: northern and southern. In the northern, more uplifted block there are more ancient and more deeply metamorphosed rocks. The orientation of folding in the northern block is sublatitudinal, whereas in the southern block it is northwesterly. In actuality, the upper deep levels cannot be traced into the Sikhote-Alinskaya folded region, as believed, and the lower level cannot be traced reliably. A change in the strike of structural elements at deep levels in the southern block from northeasterly to sublatitudinal makes it possible to postulate a considerable role of horizontal movements in the formation of this part of the complex; the dynamics of the southern block is related to the mobility of the adjacent Sikhote-Alin region. Figures 2, tables 1; references: 14 Russian.
[225-5303]

GENERALIZED POLYCONIC PROJECTIONS

TOLSTOVA, T. I.

[Abstract] A global study of the earth's surface requires cartographic representation of large areas and the earth as a whole. Polyconic projections are used extensively for this purpose and these are examined in this article in their various modifications. The following are examined: equal-area polyconic, equal-angle polyconic, polyconic with equally spaced parallels and equidistant polyconic (equidistant along the central meridian). With respect to equal-area variants, a variant is described which is of practical interest for representation of the territory of the USSR: area distortions are absent at all points and at the main parallel there are no distortions of lengths, angles and areas. In comparison with equal-area conic projections in this case the central part of the territory is depicted with small distortions and angle distortions increase only at the extreme meridian. In an equal-area polyazimuthal projection there is a central linear meridian which is not distorted and there are no distortions at the pole. In equal-angle polyconic projections a representation is obtained under the condition of a similarity of infinitely small figures or a nondependence of the length scales at a particular point on direction. An equal-angle polyazimuthal projection can be obtained in which the pole is depicted without distortions and distortions of lengths and areas are absent at the meridian 90°. In another class of polyconic projections the length scale at any fixed parallel is constant and the parallels are equally spaced. A variant is proposed which can be used in representing the territory of the USSR with small distortions (in comparison with known conic projections the distortions are less and are distributed in such a way that they increase only at the extreme meridian of the territory of the USSR). In a polyazimuthal projection with equally spaced parallels there are no distortions of lengths on the parallels, distortions of lengths, angles and areas are absent at the central meridian and all types of distortions are absent at the pole point. Another class of polyconic projections with equally spaced parallels has the following properties: the central meridian is not distorted, the parallels are drawn as radii as in conic projections, the parallels are equally spaced and the length scale along the parallels has the same expression as in conic projections. Thus, the article examines a full system of projections with circular parallels which are of interest for the cartographic representation of large territories. Figures 4; references: 2 Russian.
[225-5303]

NEW DATA ON DEEP STRUCTURE OF URALS (RESULTS OF INVESTIGATIONS ALONG
KRASNOURAL'SKIY DEEP SEISMIC SOUNDING PROFILE)

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[Abstract] During the years 1975-1979 the "Uralgeologiya" Geological Production
Combine and the Geophysical Institute, Ural Scientific Center, USSR Academy of
Sciences carried out deep seismic investigations along the Krasnoural'skiy profile
(length 400 km) along the line Dobryanka-Chusovoy-Krasnoural'sk-Makhnevo. New
and improved work methods were employed. The profile intersects Ural structures
where they are most fully developed. The seismic and geological sections are
represented in diagrams. The Mohorovicic discontinuity is characterized by a
boundary velocity 8.2-8.5 km/sec and has a downwarp under the Ural structures with
an amplitude up to 20 km. The greatest crustal thickness is in the Tagil'skiy
downwarp (54-58 km) and the Central Ural uplife (50-54 km). At a depth of 80-100
km there is a seismic boundary within the upper mantle along which there is a down-
warp in the Tagil'skiy block region synformal with the Mohorovicic discontinuity.
The principal characteristic of the crystalline crust in the Urals is a complex
layered-block structure with a clearly expressed horizontal and vertical zonality
and a considerable fragmentation by deep faults. The ancient consolidated crust
of the Urals differs from the surrounding structures in having increased physical
parameters (velocity 0.2-0.4 km/sec and density 0.2-0.25 g/cm^3 greater). For the
first time it has been possible to divide the geosynclinal system on the basis of
characteristics of deep structure into two regions (segments): western, which
takes in the western slope of the Urals, and eastern, to the east of the Serovsko-
Maukskiy deep fault. The Tagil'skiy block, situated between them, having specific
crustal structure characteristics, nevertheless retains many deep structure fea-
tures characteristic of the western segment. On the basis of the newly collected
materials it was possible to replace the traditional vertical breakdown of the
crystalline crust into granite and basalt layers by a three- to five-layer crustal
model, almost everywhere in the middle part of the crust with a layer having a
reduced velocity with a maximum thickness on the western and eastern slopes of the
Urals. The new data enabled the authors to draw definite conclusions concerning
the structure and history of crustal formation in the Ural geosynclinal system.
In order to confirm these conclusions a site has been selected along this profile
for the drilling of a superdeep hole. Figures 1; references: 9 Russian.
[230-5303]

POSSIBLE MECHANISM OF ELASTIC WAVE ABSORPTION IN EARTH'S MANTLE

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and Geochemistry

[Abstract] A great number of phenomena leading to the attenuation of elastic waves
in rocks have been considered up to the present time, but none fully explain the
observed dependence of the absorption coefficient and propagation wave velocity on
frequency. This can be attributed to the fact that until now the predominant
absorption mechanisms have not been determined; these mechanisms may be different in
the regions of low and high frequencies. The author here considers the region of
low frequencies and great depths of interest for seismology, as the dominant
absorption mechanism examining the mechanism of viscous losses in a thin contact
layer which occurs with the propagation of transverse waves of the corresponding
polarization along the nonrigid boundary of identical half-spaces. Such boundaries
can exist in rocks at great depths between individual grains (blocks). The consid-
ered case is when the contact layer has the properties of a classical Maxwell
medium. With polarization of the wave perpendicular to the discontinuity the trans-
verse body wave is transformed into a wave of the surface type and experiences
additional absorption. The considered absorption mechanism must also be manifested
in the propagation of longitudinal waves. The mechanism of viscous losses in a thin
contact layer, considered here in many of its ramifications, is entirely consistent
with observational data and can be applied in formulating a physical theory of
elastic waves in rocks at great depths in the seismological frequency range.
Figures 1; references 4: 2 Russian, 2 Western.
[230-5303]

MODEL OF CRUSTAL-UPPER MANTLE STRUCTURE ALONG CENTRAL ASIA-CAUCASUS LINE

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[Abstract] It is necessary to obtain an optimum model of crustal-upper mantle
structure along the line Central Asia-Caucasus in order to ascertain the dynamic
parameters of strong earthquakes in Central Asia. The seismic waves registered on
seismograms are frequently distorted by microseisms and noise caused by the signal

itself. The wave pattern is complex and the study of waves with the use of its time record of spectrum in the analysis of surface waves may be unreliable. The desired result can be obtained by examination of a two-dimensional spectral-time representation (SVAN--spektral'no-vremennoy analiz); the basic principle here is the replacement of one-dimensional representations of the signal f(t) by a two-dimensional spectral-time representation $Y(\omega, t)$. The spectral-time analysis method essentially involves linear filtering of the input signal f(t) by a set of narrow-band frequency filters and the representation of the spectrum of the filtered signal through its envelope and phase in the form of a function of time and the central frequency of the filter. This method gives extremely good results in the discrimination of weak signals, separation of interfering waves, determination of the dispersion of group and phase velocities of individual harmonics. This method was used in analyzing the records of Rayleigh surface waves from strong earthquakes in Central Asia for the period 1970-1976 for computing the group velocities of Rayleigh waves along the central Asia-Caucasus line. This path is characterized by a complex structure (Tien Shan orogenic region, Turan Platform, Caspian Sea, Caucasus). A theoretical model of the crust and upper mantle was constructed. A table gives the distribution of velocities of longitudinal and transverse waves as well as densities as a function of depth. In the formulated model of a plane earth it is possible to discriminate four main layers with a total thickness of 45 km situated above the upper mantle: sedimentary, with a thickness of 3 km, granite, with a thickness of 12 km, intermediate, with a thickness of 10 km, and basaltic, with a thickness of 20 km. Figures 1, tables 1; references: 2 Russian.
[234-5303]

COMPUTING ELECTROMAGNETIC SOUNDING FIELDS USING INTEGRALS ALONG TRAJECTORIES

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I. V. Kurchatov

[Abstract] Electromagnetic methods for investigating the earth's crust have been developing intensively during recent years. The reliability and volume of information on the geoelectric section is determined not only by the quality of the experimental data, but also the accuracy of solution of the inverse problem: determination of conductivity of the medium from measurements of the electro-magnetic fields at its surface. It is most common to use a model of a horizontally layered medium whose parameters (conductivity and thickness of the layers) must be determined. Computation of the fields in this model is relatively simple. However, a horizontally layered model is not always applicable. In such cases more complex

models of the medium must be used, but this is not easily accomplished, particularly
if conductivity is dependent on three space coordinates. General algorithms for
computing the electromagnetic field in a three-dimensional grid cannot be used
because the volumes of computations and the required storage surpass the capabili-
ties of modern computers. Until now work in this direction has been relatively
limited, with computations being made with a two- or one-dimensional grid.
Accordingly, the authors propose the use of the method of integration along trajec-
tories for solution of the evolutionary equations for an electromagnetic field.
It has been successfully employed in many applications, but never before for com-
putations of electromagnetic fields in inhomogeneous media (for examples of appli-
cations in other fields see I. M. Gel'fand, et al., IZV. VYSSH. UCHEBN. ZAVED.,
MATEM., Vol 6, No 5, 32, 1958; G. I. Marchuk, et al., METOD MONTE-KARLO V PROBLEME
PERENOSA IZLUCHENIY (Monte Carlo Method in the Radiation Transfer Problem), Moscow,
Atomizdat, 1967.) Application of the method here is illustrated in computations of
the vertical component of the magnetic field of dipole sources in the presence of
an inhomogeneous thin layer, a model which describes a thin stratum of sedimentary
rocks lying on a crystalline basement; the method was tested on an electronic com-
puter. The advantages of the method are as follows. It makes possible a suffi-
ciently rapid computation of the field at a single point at a stipulated moment in
time, obtaining only those numbers which are necessary for comparison with experi-
mental data in solving the inverse problem. This is especially advantageous in
the first stages of selection of parameters of the model. The method does not
require a large computer memory and can be applied using minicomputers which might
be available at field data processing centers. This would afford a possibility
for routine interpretation of field data and would make it possible to select the
points at which measurements would be most important for more precise determination
of the geoelectric section. Field computations can be made over a three-dimensional
inhomogeneous medium. Figures 2, tables 2; references 9: 8 Russian, 1 Western.
[212-5303]

ASYMPTOTIC METHOD FOR SOLVING INVERSE DYNAMIC PROBLEM IN WAVE PROPAGATION THEORY

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CHEVERDA, V. A., Computation Center, Siberian Department, USSR Academy of Sciences

[Abstract] A determination of the discontinuity of two media on the basis of a wave
reflected from it, known in some region $\mathcal{O}$ on the free surface $z = 0$, is among the
problems most frequently encountered in the interpretation of seismic observations.
Recently, in connection with the appearance of vibrational sources of oscillations,
the need has arisen for developing methods for solving this problem for stationary

typical section of the earth's crust in the Shatskiy Rise (reproduced as Fig. 3) and describe it in detail. It was found that the deep seismic profiling-reflected waves method, in combination with the other geophysical data collected, provided a highly representative model of crustal structure in this area and statistical modeling employed in the interpretation of these data yielded information on the fine structure of the principal crustal layers. It was possible to explain a characteristic peculiarity of these sections, the absence of extensive reflecting discontinuities, that is, the discreteness of reflecting discontinuities in the crust, as being a reflection of a block structure and the presence of lenticular bodies in the second and third layers of the ocean floor. Figures 3; references 12: 9 Russian, 3 Western.
[213-5303]

BOTTOM RELIEF AND GRAVITY FIELD OF MID-OCEANIC RIDGES AS INDICATORS OF PHASE TRANSITIONS IN UPPER MANTLE

GORODNITSKIY, A. M., LUKASHEVICH, I. P., MIRLIN, Ye. G., PRISTAVAKINA, Ye. I. and SOROKHTIN, O. G., Institute of Oceanology

[Abstract] An attempt was undertaken to explain the patterns of change of bottom relief and Bouguer gravity anomalies of the mid-oceanic ridges which are caused by phase transitions of mineral associations in the upper mantle. The initial data used were complex geophysical surveys along 17 profiles intersecting the mid-oceanic ridges of the Atlantic and Pacific Oceans along the normal to their strike (Fig. 1 in the text shows the location of these profiles). The problem also involved a determination of the age of the ocean floor on the basis of an identification of linear magnetic anomalies (the procedure used for this is described in detail). Gravity anomalies in the Bouguer reduction, with topgraphy taken into account, were transformed from a linear scale to an age scale for the ocean floor (there is a dependence between Bouguer anomalies and the age of the ocean floor). Relief was analyzed along six profiles, along each of which the regional component was approximated by a curve $\Delta h = a\sqrt{t}$. The a coefficient was determined from the condition of hydrostatic equilibrium and solution of the homogeneous heat conductivity equation without a source of heat generation for a medium which undergoes transition from a liquid to a solid state. Since the a coefficient is dependent on the density and thermal characteristics of upper mantle matter, the problem of determining the boundaries of density transitions essentially involves finding points on the averaged bottom relief profiles where the a coefficient changes its value. A solution of this problem was found. Two such points were determined and are

designated α and β. Pressure near the bottom of the lithosphere was computed at
the points corresponding to the time values α and β. The analyzed data indicate
that these α and β points correspond to zones of phase transition of upper mantle
matter from one mineral association to another. Figures 4; references 14:
5 Russian, 9 Western.
[213-5303]

DISTRIBUTION PATTERN AND SYSTEMATIZATION OF FAULTS IN SOUTHERN PART OF SIBERIAN
PLATFORM

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[Abstract] The author made a study of faults in the basement in the southern part
of the Siberian Platform concealed beneath a sedimentary cover with a thickness up
to 3-5 km. The study was made on the basis of a multisided analysis of geological
and geophysical materials. New data were obtained supplementing and expanding
former concepts. The discrimination and tracing of faults was accomplished on the
basis of well-developed geophysical criteria and their tie-in to geological data
and the results of interpretation of space photographs. This made it possible to
compile a more complete map of faults in the region and systematize them (this map
is reproduced in the text). The dislocations were systematized with respect to the
strike of the folded structures of the basement into longitudinal, transverse and
diagonal; on the basis of orientation--as submeridional and sublatitudinal, north-
easterly and northwesterly; with respect to depth--into crustal-mantle (through-
crustal) and intracrustal; with respect to geological significance--into zones of
faults separating first- (folded regions and platforms) and second-order (folded
systems) blocks; regional faults controlling third-order blocks (structural forma-
tion zones); sufficiently large faults controlling fourth-order blocks (within
structural-formation zones); higher-order (intrablock) faults. A spatial correla-
tion is established between the distribution of different minerals (not only solid,
but also fluid and gaseous), including iron, petroleum and gas, with faults and
especially with the points of their joining and intersection. On the basis of these
data it is recommended that use be made of data on fault tectonics for increasing
the effectiveness of predictive-mineragenetic and reconnaissance-exploration work
in the region. Figures 1; references: 9 Russian.
[214-5303]

KIROVOGRADSKIY DEEP MAGMATIC DIAPIR AND REGIONAL GRAVITY MINIMUM

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[Abstract] The authors have established a probable relationship between the Kirovgradskiy gravity minimum and the anomalous distribution of masses in the section of the protoplatform complex of the same name on the basis of a joint analysis of geological structure, materials from deep seismic soundings along a profile, gravimetry and known geothermal data. According to deep seismic sounding data, at depths of 8-14 km there is an upper crustal waveguide which can be identified with a region of development of sepentinites that probably supplied the matter for hyperbasite protrusions. The velocity of elastic oscillations in the waveguide is 6.0 ± 0.1 km/sec, which corresponds to a density of 2.62-2.64 g/cm^3. The nonuniformity in the distribution of reflecting elements along the deep seismic sounding profile made it possible to discriminate in the region a transcrustal acoustic anomaly identifiable with the Kirovogradskiy deep magmatic diapir of primarily ultrabasic composition. The distribution of intrusive facies is dependent on the different temperature of the magma and surrounding formations. This explains the distribution of rock density in the internal facies of the deep magmatic diapir. Only the formations of peripheral facies, situated in the lower part of the crust, retain a high density of hyperbasites; those situated above are transformed into serpentinites. The effect of the deep magmatic diapir on the covering rocks is dependent on the heating time. It is concluded that the Kirovogradskiy regional gravity minimum is caused by an anomalous distribution of masses in the upper part of the crust of the protoplatform complex, limited to a depth of 25-30 km. Deeper the density section is transformed into a horizontally layered medium. Independent geothermal data agree well with the results of gravimetric computations and these agree well with data from deep seismic sounding and a geological-petrological model. On this basis the origin of the Kirovogradskiy gravity minimum must be associated with the existence of the Kirovogradskiy deep magmatic diapir. The presence of such large intrusions in the earth's crust in no way negates the key role of regional metamorphism. Figures 1; references: 7 Russian. [221-5303]

SEISMIC MODEL OF CRYSTALLINE EARTH'S CRUST

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of Sciences

[Abstract]   The most objective information on a seismic model of the consolidated
crust is given by subcritical reflected waves. However, using standard procedures
for the interpretation of data from deep seismic soundings they cannot be identified
with definite seismic discontinuities in the crust. This is attributable to a sub-
stantial difference in the very structure of the sedimentary and crystalline parts
of the crust. Whereas the first can be represented by a regular model with exten-
sive discontinuities with smoothly changing parameters, the second can be regarded
as a heterogeneous medium with a complex distribution of small- and medium-scale
inhomogeneities slightly differentiated with respect to elastic properties. The
wave field forming in a heterogeneous medium on a system of local elements has a
complex structure dependent on both the parameters of the individual elements and
the characteristics of their spatial distribution and seems to consist of two
components. The first is a superposing of the fields of all waves singly scattered
on inhomogeneities and the second is the sum of all multiple waves reflected on two
or more elements. An algorithm is proposed for computing the wave fields for a
number of simplified models of a heterogeneous medium constituting a combination of
the regularly and diffusely distributed local elements. An example is given (the
data used are for the Ukrainian crystalline shield). On the seismic records in the
subcritical region it is possible to discriminate three types of regular waves.
The first type is represented by short groups of oscillations, rapidly attenuating,
relatively high-frequency, sometimes with a clearly expressed minimum of their
travel-time curves. Hypothetically they are associated with waves diffracted and
scattered on small inhomogeneities in the earth's crust. The second type is
represented by quite intensive groups of reflections, sometimes with anomalous
apparent velocity values, the number of which on the records increases considerably
with a widening of the band of investigated frequencies. They must be regarded as
oscillations reflected from medium-scale inhomogeneities of individual geological
contacts, tectonic dislocations, folded zones, etc. The third type is represented
by interference reflected waves evidently formed by complex discontinuity zones,
usually gently sloping. It is shown that in order to obtain the most objective
data on the structure of the entire thickness of the crystalline earth's crust it
is necessary to combine high- and low-frequency seismic prospecting methods. In
such work it is necessary to take into account the possibility of formation (under
conditions of a complexly structured heterogeneous medium) of interference waves
which (especially in the low-frequency region) can lead to erroneous structural
models. Figures 2; references: 3 Russian.
[221-5303]

UNIVERSAL REDUCTION MODEL FOR INTERPRETING GRAVITY ANOMALIES BY TRIAL-AND-ERROR METHOD

BUR'YANOV, V. B., KOZLENKO, V. G. and RUSAKOV, O. M., Geophysical Institute, Ukrainian Academy of Sciences

[Abstract]   There are two approaches in attempts to regularize the process of discriminating that part of the observed field which a gravitational model should explain. In the first approach the norm is established on the basis of a generalization of empirical data on crustal structure of geostructures of the same type in different regions of the earth on the assumption of a uniformity of the underlying mantle. In the second the reduction function is regarded as a component part of a global density model. The authors feel that the combining of the two approaches will make it possible to create a universal system for interpretation of the gravity field Δg for both the continental and oceanic segments of the earth and this will make it possible to unify the construction of regional density models and will provide a meaningful basis for combining gravimetry with other methods for investigating the earth's deep structure. It is known that the gravitational effect of the distribution of crustal density within the limits of Precambrian structures can be adopted as a norm relative to which structures of remaining tectonic types must be considered anomalous. For the oceans such a base structure is an abyssal basin with an age of the bottom greater than 40 million years. More than half the planetary surface is in fact characterized by physical parameters which can be considered normal. The authors therefore feel that a universal reduction function as its component parts should include a density column of an averaged Precambrian craton and a corresponding column of an averaged abyssal basin, since the use of a reduction function obtained by the averaging of the parameters of continental or oceanic structures of different genesis would result in the appearance of fictional gravitational effects. Proceeding on this basis, the constructed standard models of a Precambrian craton and an oceanic basin, reflecting the real structure of the earth and the processes transpiring in its deep layers will make possible a direct consideration of the most important feature of upper mantle structure: its breakdown into a lithosphere, asthenosphere and subasthenospheric layer (mesosphere). Figures 1; references 11: 9 Russian, 2 Western.
[199-5303]

ASYMPTOTIC BEHAVIOR OF SURFACE CHARGE DENSITY IN GEOPHYSICAL MODELS AND ITS
APPLICATION IN NUMERICAL ALGORITHMS

MERRIK, B. R., All-Union Scientific Research Coal Institute

[Abstract] In the excitation of an electric field in a piecewise-homogeneous medium
at the boundaries of media with different conductivity there is formation of surface
electric charges whose density $\sigma(p)$ as a function of the coordinates of a point on
the surface p satisfies the Fredholm integral equation. In earlier studies
(FIZIKA ZEMLI, No 5, 1979; GEOLOGIYA I GEOFIZIKA, No 3, 1979) the author examined
the problems involved in electrometry for the case of a borehole passing through a
system of plane-parallel layers and proposed a numerical algorithm for solving the
corresponding integral equation. Continuing this line of investigation, the author
now examines the behavior of the density functions for the surface electric charge
on the plane and cylindrical boundaries of media with different conductivity. It
is shown that for ensuring the accuracy of solution of the corresponding integral
equation for the density function it is necessary to take into account a region of
about 300-400 borehole radii along plane discontinuities and 100-150 radii along
the borehole surface. A method is proposed for taking into account quite large
regions in an integral equation based on determination of the density function in
asymptotic regions in analytical form using a series consisting of a small number of
base functions. It was possible to determine the form of the base functions and
the initial approximation of electric charge density in asymptotic regions.
Figures 5; references: 6 Russian.
[216-5303]

DETECTING SYSTEMATIC ERRORS IN RESULTS OF SEA GRAVIMETRIC DETERMINATIONS

FEDORCHENKO, V. A. and KUKLEV, V. A.

[Abstract] The presence or absence of the systematic component of the total error
in the results of sea surface and underwater gravimetric determinations is deter-
mined by comparing them with the results of earlier determinations at the points of
intersection of runs. It is necessary to find the differences d_i (i = 1, 2,...,n;
n is the number of the conjugate pair) between the results of parallel determina-
tions of the gravimetric parameter from which a conclusion is drawn concerning the

presence or absence of a systematic error. The truth of such a conclusion is
determined to a great extent by the correctness of extraction of the information
included in the statistical set of differences d_i. This, however, is not always
given due importance and this can cause an incorrect evaluation of sea gravimetric
surveys. For this reason the authors have examined some of the possible methods
for extracting this information, their merits and shortcomings, as well as the
conditions of applicability, taking into account that with a great range of change
of the horizontal gradient of the gravitational field the systematic error in
determining the gravimetric parameter can be a function of the gradient, that is,
be a variable. The methods for detecting systematic errors in double measurements
are emphasized in the geological prospecting literature for evaluating the quality
of the results of quantitative determinations of mineral components; for this
reason this article stresses this aspect of the problem. It was found that a
necessary condition for the correct solution of problems involved in detecting
systematic errors of double gravimetric determinations is that the set of differ-
ences d_i be statistically homogeneous. This condition will not be satisfied in the
following three cases: 1) when there is a functional relationship between the
systematic error and the horizontal gradient of the gravity field; 2) when there are
noncomparable pairs of results of double determinations giving rise to anomalous,
clearly expressed differences and 3) with a joint influence of the first and second
factors. In order to eliminate the influence of these factors it is necessary that
the entire range of change in the horizontal gradient of the gravity field, within
whose limits the joint determinations are made, be broken down into subranges with
a width of $1 \cdot 10^{-5}$ m/sec$^2 \cdot$km and that the problem of detection of the systematic
error be solved within the limits of each of these subranges separately, after
first excluding the anomalous differences. The literature gives many methods for
excluding anomalous measurement results but they postulate a normal distribution of
measurement errors. It is shown here how it is possible to exclude anomalous dif-
ferences in double gravimetric determinations by use of the Fisher test, which with
an adequate degree of accuracy can also be applied to the results of measurements
not having a normal distribution. In the latter case the only requirement is that
the number of degrees of freedom of the dispersions be not less than three.
References: 8 Russian.
[218-5303]

PHYSICS OF ATMOSPHERE

EVALUATING PARAMETERS OF WIND CAPTURE OF RADIOACTIVE DUST FROM EARTH'S SURFACE

MAKHON'KO, K. O., Institute of Experimental Meteorology

[Abstract] In an earlier paper (IZV. AN SSSR: FAO, Vol 15, No 5, 1979) the author described model experiments carried out under natural conditions by the tagged atoms method for determining the effect of wind capture of dust from the underlying surface. The considered effect was characterized by the wind capture coefficient a. Using his earlier work as a point of departure, the author has now developed a method for estimating the effect of wind capture from the underlying surface for the aerosol products of nuclear explosions everywhere accumulating in the soil as a result of the gradual self-purification of the atmosphere from radioactive contamination (in this case the method developed earlier for determining a cannot be used, although it can be used for developing the required method). First an equation is given for the vertical propagation of an impurity; next an expression is given for the parameter v_a, characterizing the wind capture of radioactive dust of global origin from the land surface; this leads to an expression for the concentration of long-lived isotopes in the air caused by wind capture from the soil surface; finally, an expression is derived for v_a in which all the parameters can be found experimentally. Computations of v_a and a were made for the summer months of 1969 for the Moscow region (as the long-lived isotope use was made of cesium-137, and as the short-lived isotope the sum of zirconium and niobium-95). Strictly speaking, the presented wind capture parameters for the radioactive products of nuclear explosions from the soil surface are correct only for the radiation conditions characteristic for the summer of 1969. After fallout onto the underlying surface, with the passage of time radioactive isotopes, as a result of migration into the depth of the soil, to an ever-lesser degree enter into the atmosphere as a result of wind capture. Accordingly, during the period of the moratorium on the testing of nuclear weapons the parameters of wind capture should decrease in value. References 8: 6 Russian, 2 Western.
[223-5303]

MODEL OF ATMOSPHERIC EDDY

ANISIMOVA, Ye. P., BELOV, Yu. N., SPERANSKAYA, A. A. and SHANDIN, V. S., Moscow State University

[Abstract] The article gives the first results of investigation of the structure of a model of an atmospheric eddy system created under laboratory conditions in which there was reproduction of the fields of velocity, temperature and humidity close to the corresponding characteristics of tropical hurricanes. The experimental apparatus was a cylindrical shell 60 cm in diameter and with a height of 80 cm; warm water was placed in this container and this layer, with a depth of 10 cm, was maintained constant and equal to $60 \pm 2^{\circ}C$. Angular momentum in the system was created by a vane situated in the upper part of the apparatus at a distance of 100 cm from the underlying surface. The vane was in the form of a cylinder with a diameter of 30 cm and a height of 10 cm within which there were four blades. The frequency of rotation of the vane varied from 9 to 20 Hz. A concentrated eddy developed in the interaction of the circulating air flow created by the vane with the water surface. The eddy was a visible rotating column of water vapor with a vertical dark core at the center. The diameter of the visible part of the eddy (2R) was 20-25 cm and the diameter of the dark core was 8-10 cm. An analysis of temperature measurements in different regions of the eddy indicated that the maximum temperature anomalies exist at the core of the eddy and the maximum temperature gradients are observed in its visible part. The vertical temperature profiles, measured at different distances from the center of the eddy, have two reliable maxima: one at a distance of 2.5 cm from the underlying surface and the second at a height of 15-20 cm. In the examined eddy structure the maxima in the vertical distribution of temperature can be governed not only by the thermal convection mechanism, but also by water vapor condensation. The distribution of temperature and relative humidity in the laboratory eddy system is close to the data in the literature on the structure of real hurricanes. The radial and vertical velocity components in the model were evaluated by visual observations made using dry ice; these revealed the presence of a radial velocity component in the near-water boundary layer and the existence of an ascending movement of air in the visible part of the eddy. Such visualization of the velocity field also revealed that the movement of air masses in this region of the concentrated eddy has a spiraling character. The data from visual observations of the radial and vertical velocity components also confirm the similarity of the velocity field obtained in this laboratory eddy model and the velocity field in a hurricane. These and other findings reveal that the laboratory model was a highly successful reproduction of the actually observed hurricane conditions. Figures 3; references 7: 6 Russian, 1 Western.
[223-5303]

REGISTRY OF DISTORTIONS OF TEMPORAL STRUCTURE OF OPTICAL PULSE TRANSMITTED
THROUGH AEROSOL LAYER

GAVRIKOV, V. K. and KORENEV, V. G.

[Abstract] The propagation of a short light pulse through an aerosol layer is
accompanied by distortion of signal spatial-temporal structure. This phenomenon
is caused by summation of multiple scattered and direct radiation at the reception
point (in optically dense aerosols their intensities become comparable). The
problems associated with distortion of the temporal structure of the pulse are
important for optical communication, range finding and remote sounding of scatter-
ing media and have been investigated by statistical modeling and analytical methods.
Both approaches make it possible to evaluate the temporal broadening of a pulse as
a function of the scattering medium parameters. However, the literature contains
no descriptions of model experiments making possible more precise checking of
scattering medium parameters. This article gives the results of registry of dis-
tortions of the temporal structure of a light pulse transmitted through an artifi-
cial fog. A study was made of the propagation of an individual pulse of coherent
radiation ($\lambda = 0.53\mu m$) in an artificial fog which was created by the evaporation of
water in a special chamber. This method made it possible to create in a chamber of
relatively small dimensions (1.2 x 2 x 4 m, path length L = 4 m) an artificial fog
with the optical thickness $\tau > 40$. Figure 1 is a block diagram showing eight of
the principal elements of the optical system, whose functioning is described in
detail. The observed broadenings of the pulse are compared with some theoretical
estimates. The observed increase in the duration of the light pulse is described
well by computation formulas proposed by such authors as Bucher, Ishimaru and Stotts.
Figures 3; references 8: 2 Russian, 6 Western.
[223-5303]

OBSERVING AN OBJECT THROUGH INHOMOGENEOUS SCATTERING MEDIUM

KATSEV, I. L., Physics Institute, Belorussian Academy of Sciences

[Abstract] The signal-to-noise ratio is one of the principal parameters determining the image quality of an object when making observations through a scattering medium. General expressions have been derived for the signal-to-noise ratio for the case of a homogeneous medium and photoelectronic registry when the principal contribution to noise is from shot fluctuations of the photocurrent. However, in the formation of a real image, in addition to shot noise, determined by the mean signal level in the photodetector, there is a noise component governed by the random modulation of the signal due to fluctuations of medium parameters. In some cases, such as in observation through an inhomogeneous cloud, its contribution may be comparable with and even exceed the contribution of the shot noise. Accordingly, the author takes this factor into account in deriving a formula for the signal-to-noise ratio in the image of an object observed through a spatially inhomogeneous medium and for a typical situation compares the quality of the image transmitted through homogeneous and inhomogeneous media. References: 3 Russian.
[223-5303]

INVESTIGATING CHARACTERISTICS OF NATURAL AEROSOL AND ITS TRANSFORMATION PROCESSES

LYUBOVTSEVA, Yu. S., YUDIN, N. I. and MEL'NIKOV, N. V., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] The article gives some results of three expeditions of the Section on Aerosol Optics, Institute of Atmospheric Physics, in the pine forests of Lithuania (1976) and in the mountains around Abastumani at an elevation of 2,000 m (1975 and 1978) for determining the variability of the characteristics of aerosol when there is a change in air masses and in different processes of aerosol transformation under conditions of a constant air mass. A thermooptical nephelometer was used in tracing the processes of heterogeneous condensation of volatile components on non-volatile nuclei always present in the atmosphere. It is shown that at Abastumani

(1978) the change in the quantitative characteristics of the aerosol is determined for the most part by the process of heterogeneous condensation of volatile components on the surface of moistened particles with the subsequent formation of sulfate particles. The natural aerosol at Abastumani (1978) consists 50-60% by mass of sulfates. The contribution of the volatile and nonvolatile components to the total mass of submicron particles of natural aerosol is estimated. The mass concentration of the volatile component of natural aerosol at Abastumani (1978) varies in the range 5 $\mu g/m^2 \leqslant m_{vol} \leqslant$ 45 $\mu g/m^3$, in Lithuania—4 $\mu g/m^3 \leqslant m_{vol} \leqslant 14 \mu g/m^3$. The nonvolatile component is equal to 4 $\mu g/m^3 \leqslant m_{nonvol} \leqslant$ 13 $\mu g/m^3$ at Abastumani and 8 $\mu g/m^3 \leqslant m_{nonvol} \leqslant$ 40 $\mu g/m^3$ in Lithuania. Thus, at Abastumani the principal changes in the quantitative characteristics of aerosol were associated with the heterogeneous condensation process and in Lithuania with the processes of photochemical synthesizing of particles. Accordingly, the chemical composition of the submicron fraction of natural aerosol in Lithuania and Abastumani is completely different: at Abastumani the main mass of particles is readily soluble and volatile, whereas in Lithuania it is insoluble and nonvolatile. Figures 5; references 13: 10 Russian, 3 Western.
[223-5303]

SYSTEM FOR AUTOMATIC PROCESSING OF RADIOACOUSTIC SIGNAL AT REAL TIME SCALE

AZIZYAN, G. V., KARYUKIN, G. A. and PETENKO, I. V., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] In the operation of a radioacoustic sounding system using continuous radio radiation the scattered signal is also continuous radiation with a frequency displaced relative to the transmitted frequency by the value $\omega_g = (2v/c)\,\omega_0$, where v/c is the ratio of the speed of sound at a particular point to the speed of light, ω_0 is the frequency of the sounding radiation. After transformations in the radar high-frequency channel the frequency of the scattered signal is reduced by the value ω_0 and at the radar output there is a signal with the frequency ω_g, whose value changes as the sonic pulse becomes more distant from the source. The factors exerting the greatest influence on ω_g are temperature and the vertical component of wind velocity in the scattering volume (in the case of vertical sounding). This article describes a system which during the time of propagation of each sonic pulse makes it possible to ascertain ω_g at 24 points fixed in altitude. The presence of a microcomputer in the processing system makes it possible to introduce information on each separately measured profile into the operational memory of the computer and thereafter compute the mean temperature profile and the error with which temperature

is determined at each altitude. Figure 1 in the text is a block diagram of this automatic processing unit; 11 components are identified. After introduction of data on 16 profiles into the microcomputer the latter is cut off from external sources and processing of stored data begins. The processing program included computation of the mean temperature and the temperature dispersion at each fixed altitude for the 16 individual profiles. The entire processing procedure requires 70 sec, which together with an input time of 80 sec totals the 3 minutes necessary for determining a mean temperature profile. In order to determine frequency with an accuracy to 10^{-4}, corresponding to a mean square error in determining temperature of about 0.05°C, it is sufficient that the signal exceed noise by 5-6 db (with greater signal-to-noise ratios the accuracy in determining frequency is determined by the width of the signal spectrum). Figures 3; references 4: 2 Russian, 2 Western.
[211-5303]

BISTATIC SCHEME FOR ATMOSPHERIC RADIOACOUSTIC SOUNDING

KON, A. I., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] In the practical realization of radioacoustic sounding systems it is customary to use a bistatic scheme with a symmetric arrangement of the source and receiver of radio waves relative to the sound source. This fact is usually not taken into account in theoretical evaluations and the noncoincidence of the directions of the sound and radio waves is taken into account only by a modification of the Bragg condition. In theoretical computations it is necessary to introduce an additional parameter characterizing the extent of the region from which in principle the reception of radio waves is possible. This makes it possible to clarify the qualitative picture of the phenomenon, but for making quantitative evaluations it is necessary to compute the scheme which is used in a real experiment. Moreover, in theoretical evaluations of energy, scattered signal spectra, influence of different atmospheric parameters, etc., it is customary to represent the interacting wave beams in the form of directed spherical waves. This also imposes limitations on the use of theoretical computations for quantitative evaluations because in actuality the beams are of finite dimensions, experiencing diffraction during atmospheric propagation. This circumstance can play an especially important role in the region of minimum sounding distances where the directional diagram of the sources has still not been formed and the use of the approximation of directed spherical waves is known to be incorrect. The author has endeavored to overcome all of the enumerated shortcomings by computing a bistatic sounding scheme with the use of diffracting wave beams formed by antennas of some finite dimensions. Figures 1; references 6: 4 Russian, 2 Western.
[211-5303]

ROLE OF RADIATION ATTENUATION MECHANISMS IN WINDOW 8-13 μm UNDER DIFFERENT METEOROLOGICAL CONDITIONS

DIANOV-KLOKOV, V. I. and IVANOV, V. M., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] In earlier studies (IZV. AN SSSR: FAO, Vol 14, No 8, 1978; Vol 15, No 6, 1979)the authors demonstrated that in microwindows in the range 10-13 μm for a description of the observed attenuations of radiation in the slightly turbid atmosphere in Antarctica, in the temperate latitudes and in the tropics it is sufficient to take into account only absorption in the water vapor continuum; in the microwindows of the region 8-10 μm the measured attenuations exceed the computed values. Therefore, it was postulated that minor gas constituents play a considerable role in the microwindows in the range 8-10 μm in the case of the low moisture content in Antarctica. Using this as a basis for this further investigation, the authors make a quantitive comparison of the molecular optical thicknesses in the microwindows of the interval 8-13 μm, computed taking into account both absorption in the water vapor continuum and selective absorption by water vapor and minor gas constituents of the atmosphere. The data analyzed here on transparency in the microwindows in the interval 8-13 μm for the case of a slightly turbid atmosphere ($S_M \geqslant 10$ km) do not indicate any significant influence of aerosol. In the microwindows of the subregion 10-13 μm the water vapor continuum is the only essential absorption mechanism. In the subregion 8-10 μm selective absorption by minor gaseous constituents is the most important. Figures 4; references 13: 12 Russian, 1 Western.
[211-5303]

ARCTIC AND ANTARCTIC RESEARCH

ANTARCTIC DRILLING AT RECORD DEPTH

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 24 Jul 81 p 2

[Text] A thermal drilling apparatus "thrust" by Soviet polar workers into the ice shield near the inner-continental Antarctic station "Vostok" reached a record 1.5 kilometer mark. The leader of the expedition radioed news of this achievement to the Arctic and Antarctic Scientific Research Institute.

While commenting on the news, Deputy Director of the Institute Ye. Korotkevich said that the original thermal drill which was made by specialists of the Mining Institute imeni G. V. Plekhanov did not simply pass through a great mass of ice; it also placed at the disposal of researchers an enormous column of core sample. 1500 meters is a unique "chronicle" of the planet which has been preserved by the cold for many tens of thousands of years.

Isotope and chemical analysis of the core sample which is extracted meter after meter by the drilling apparatus will help to interpret the weather and climate, the gas composition of the atmosphere, the temperature and humidity, and the volcanic activity of the distant past. In the future, there will be many interesting discoveries. Microbiologists, for example, have already succeeded in reviving microorganisms which have been "dozing" in an anabiotic state thousands of years.

The final goal of the project is to pass through the entire ice shield of the continent (approximately 3500 meters) to the geologic rocks that make up Antarctica.

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71

DRILLING IN ANTARCTICA

[Excerpt] The success of the drillers in Antartica is the result of many years of creative collaboration between specialists of the Leningrad Mining Institute imeni G. V. Pkekhanov and the Arctic and Antarctic Scientific Research Institute.

The pro-rector of the mining institute and Doctor of Technical Sciences B. Kudryashov remarked that a method for the passing of the borehole and the taking of ice core samples that was viable in such conditions was found when together with the senior scientific employee of the Arctic and Antarctic Institute N. Barkov we began to build a thermal drilling apparatus.

We saw one of them in the laboratory of the institute. Before us was a hollow metal shaft with a length of six feet. On the inside there were different devices. At one end there was a ring-like electrical heater. At the other end there was a cable protected with plating.

Just such an apparatus in Antarctica has passed through 1.5 kilometers of ice, and the leader of a group of drillers, Eduard Zagrivnyy, reported that it is still boring deeper. B. Kudryashov explained that in addition to the thermal drilling apparatus which does not cut the ice but melts it, the equipment complex includes winches, an electrical cable, and an electrical power supply.

An easy and reasonable solution was not found immediately. How, for example, could the core sample be extracted from below in such a way that the purity of the experiments of the glaciologists was not affected? What was one to do with the water formed by the melting of the ice? How could one control the apparatus at great depths so that it would not move arbitrarily to one side?

Now everything seems new and original in the construction. The three-meter core sample which is cut out by melting passes through the collar of the heater and gradually enters a receiving reservoir-pipe. Above it another pipe is placed for collecting melted water which is pumped out of the zone of melting via several small pipes using a small pump mounted inside the thermo-drill. The drilling takes about an hour and the hoisting about two hours.

The drilling passed routinely down to a depth of 950 meters. Then it appeared that one could not drill below this depth. The apparatus had to be brought to the surface and the core hole at the bottom had narrowed due to mountain pressure. At last the problem was resolved. New technology required changes in the construction of the thermo-drill. The day when the apparatus provided a core sample from a depth of one kilometer and a zone was reached that was again favorable for work was a festive occasion for the drilling detachment of V. Chistyakov.

It is intended to penetrate at least two kilometers of the glacier.

72

BRIEFS

27TH SOVIET ANTARCTIC EXPEDITION--Leningrad--Preparations for the dispatch of the 27th Soviet Antarctic Expedition to the shores of the sixth continent are being completed. The expedition's chief, Candidate of Technical Sciences D. Maksutov, said "About 700 people will be sent by ship on the distant cruise. The seasonal bases 'Druzhnaya-1' and 'Druzhnaya-2' on the south bank of the Weddell Sea will be the principal summer bases. Geophysical, geological, aero-geophysical, and other detachments will be located there." Scientists will work on defining the deep construction of the earth's crust and the physical characteristics of mountain rocks. Aero-methods will be used extensively. Six ships will bring provisions and a new staff of polar workers. They will take on board participants of the 26th Expedition who have completed their scientific tour and will take them back to the Soviet Union. Airplanes will bring about 150 people to the ice continent via the air route from Moscow and Leningrad to Antarctica. [Text] [Moscow IZVESTIYA in Russian 4 Sep 81 p 6]

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